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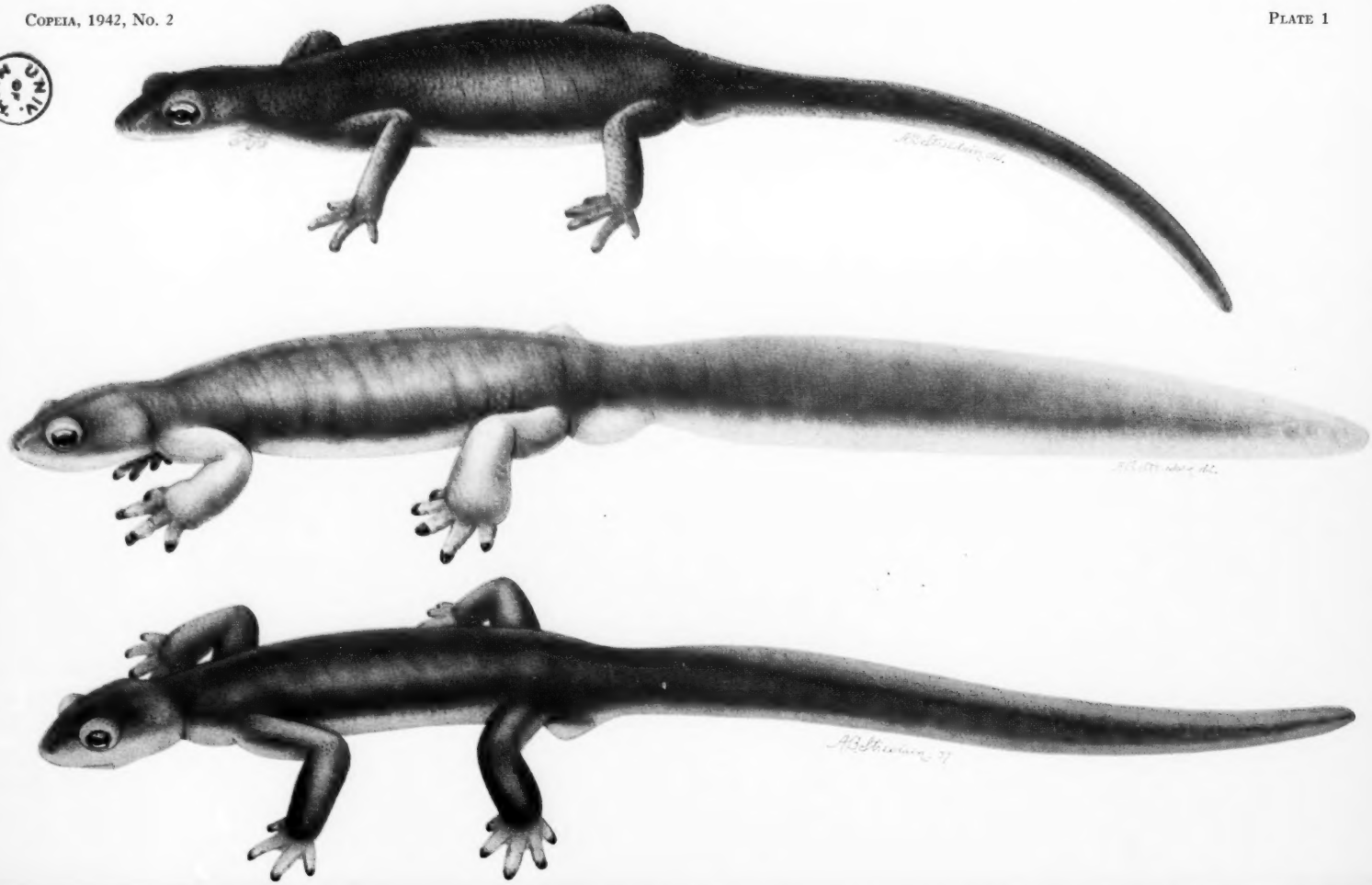


The Species of Californian *Triturus*

By Victor Chandler Twitty

SINCE the description by the writer in 1935 of two new species of Californian *Triturus*, in addition to the long known *Triturus torosus*, further search has revealed the existence of additional representatives of this genus in the Pacific states. The first object of the present paper is to describe one of these, from the foothills and higher western slopes of the Sierra Nevada, as a new species. An additional form, from Crater Lake in Oregon, is described in this same issue of Copeia as a sub-species of *T. granulosus* [1] by Dr. George S. Myers. A third type, from the coastal region of southern California, will be briefly mentioned herein, but will not be named as a separate form in view of the fact that its known distinctive features do not lend themselves readily to systematic diagnosis.

In addition, opportunity is taken to present color plates of the species of Californian *Triturus*. It was my original intention to withhold publication of the latter until data on these species accumulated over a period of years could be presented in some detail, including a summary of studies on their development, artificial hybridization (Twitty, 1936), etc. However, since the prospects of completing such an account in the near future are uncertain, it was decided to include the plates in the present publication, and at the same time to extend the scope of the article to encompass at least a brief account of the entire genus as represented in California.

Triturus ***sierrae***, new species

Type.—Stanford Natural History Museum No. 2425, from Cherokee Creek, in the hills above Chico, Butte County, California, collected April 9, 1937, by V. C. Twitty and G. S. Myers.

Paratypes.—Nos. 2426-2447, collected with the type; Nos. 2448–2465, and 2491–2497, from small streams near Megalia Dam, also in the vicinity of Chico, taken by the same collectors on the same date; and Nos. 2755–2768, collected by Dr. Enders and class from Chico State College, at Chico Creek, Butte County, California, April 8, 1937.

Adult and larval specimens in the Stanford Natural History Museum identified as of this species include also: Nos. 3018–3021, collected by Leo Shapovalov near the Placerville-Lake Tahoe Highway between Pacific House and Riverton, Eldorado County, California, June 16, 1937; Nos. 6500–6505,

[1] Fitch (1938) has revived this name, originally applied by Skilton (1849) to newts collected in Oregon by Carey, to take precedence over *similans* Twitty, on the grounds that this is the only form of *Triturus* known to occur in the portion of Oregon visited by Carey.

Plate 1

Above: adult *T. torosus* female. *Middle:* adult *T. torosus* male in breeding condition. The extreme glandular development during the mating season leaves the skin of *Triturus* males in a smooth, transparent condition, almost jelly-like in consistency. The color of the skin during this period is characteristically quite pale in *T. torosus*, although it may be sometimes considerably darker than in the specimen shown here. *Below:* male of *T. sierrae* in breeding condition. All drawings approximately 1.2 natural size.

collected by Shapovalov, Fisher and Fisher, at elevation of 2450 feet in Bear Creek, Whispering Pines Resort, Mariposa County, February 22, 1941; Nos. 6271–6276, collected by Earl S. Herold, in Laurel Lake above Hetch Hetchy Dam, Tuolumne County, California, at an elevation of approximately 6700 feet, about August 1, 1937; Nos. 1798–1801, collected by Cloudsley Ritter in Antelope Creek, Placer County, August 6, 1899.

Egg Clusters.—No. 3338, collected near Centerville, Butte County, California, and No. 3339, at Cherokee Creek, Butte County, California, by the writer and George S. Myers on April 9, 1937.

Additional living eggs and adults collected 25 miles north of Fresno, California, on the Clovis-Auberry Road, were shipped to the writer during March, 1940, by W. J. Frech.

Diagnosis of Adults.—Coloration (Plate 1) approximately chocolate brown above and burnt orange below; upper eye-lids and adjacent skin overlying eye-ball conspicuously lighter than rest of dorsal skin surface (this distinction sometimes observed in *T. torosus,* but much less characteristic, particularly of females, and seldom as well marked); iris pigment marked whitish silver, brighter, and better filled out than in iris of *torosus;* tail fin of breeding males definitely less well developed than in *torosus.* (For further comparisons with adults of other species, see below.)

Measurements of Type.—Total body length, 174 mm.; snout-anal length, 72 mm.; head length (tip of snout to gular fold), 19 mm.; greatest head width, 16 mm.; interorbital distance, 5.5 mm.; anterior angle of eye-lids to external nares, 5.5 mm.; length of eye, 4 mm. (measurements from alcoholic specimen).

Life History.—The principal observations on spawning were made on April 9, 1937, at the type locality, where large numbers of adults were found in the acts of mating [2] and deposition of eggs. The latter were laid in approximately spherical clusters, containing from 11 to 22 eggs (based on counts of 12 clutches chosen at random), and attached to the overhanging and under surfaces of variously sized stones situated in the stream-bed. Several eggs measured subsequently in the laboratory averaged about 2.8 mm. Spawning occurred in relatively swift water. A short distance downstream the current slowed as the brook issued from its canyon into a meadow, and here no adults or eggs were found. However, the spawning of *sierrae* is not confined to rapid water. On the same date, at another locality near Chico, adults were depositing eggs on roots in a small artificial ditch almost devoid of current.

Young larvae are characterized by a pigment pattern suggestive of, but immediately distinguishable from, that of *T. torosus* (compare *a* and *c,* Plate 4). Black dorsal pigment bands are present as in the latter, but their margins are less evenly formed, and many more melanophores are present farther ventrally on the sides than in *torosus.* There is also much more yellow pigment (xanthophores) in young larvae of *sierrae* than in those of *torosus.* In advanced larval stages, conspicuous black pigment clumps appear over the entire sides, creating a distinct maculation never observed in *torosus* (compare *a'* and *c'*, Plate 4).

[2] For an account of mating behavior in Californian species of *Triturus,* particularly *torosus,* see Smith, 1941, *a* and *b.*

Relationships of *T. sierrae* to Other Californian *Triturus*

The four Californian species of the genus *Triturus* appear to be classifiable into two principal categories. One of these is represented by *T. granulosus*, while the second comprises the three remaining species, *torosus*, *sierrae* and *rivularis*.

Within this second group, *sierrae* seems to have its closest affinities with *torosus*. For example, although the two species are readily separable on the basis of coloration, the pigmentation of *sierrae* clearly is more suggestive of *torosus* in both larval and adult stages than of *rivularis* (see color plates 1 and 2, and Plate 4). The brightly pigmented iris in the eyes of both species immediately distinguishes them from *rivularis*, so readily diagnosed by the dark brown coloration of its eye. (Note: this distinction is reliable only in living specimens, since preserving fluids reduce or remove the bright eye-pigments of the other species.) *Triturus sierrae* and *torosus* also share the habit of spawning in both rapid and quiet water, whereas *rivularis* is known to deposit its eggs only in mountain brooks. Furthermore, the egg clusters are typically spherical in both of the former species, flattened in the latter. The distinctive larval organ known as the balancer is well developed in *torosus* and *sierrae*, absent or incompletely developed in *rivularis*.

On the other hand, *sierrae* is not entirely lacking in features suggestive of *rivularis*. The eggs, for example, are approximately identical in size, much larger in both species than those of *torosus*. *T. sierrae*, like *rivularis*, also often manifests a marked tendency to deposit its egg clusters beneath stones, a habit never observed in *torosus* even when spawning in streams affording suitable opportunities. The tail fin of breeding males is somewhat better developed than in *rivularis*, but definitely reduced in comparison with that of *torosus*.

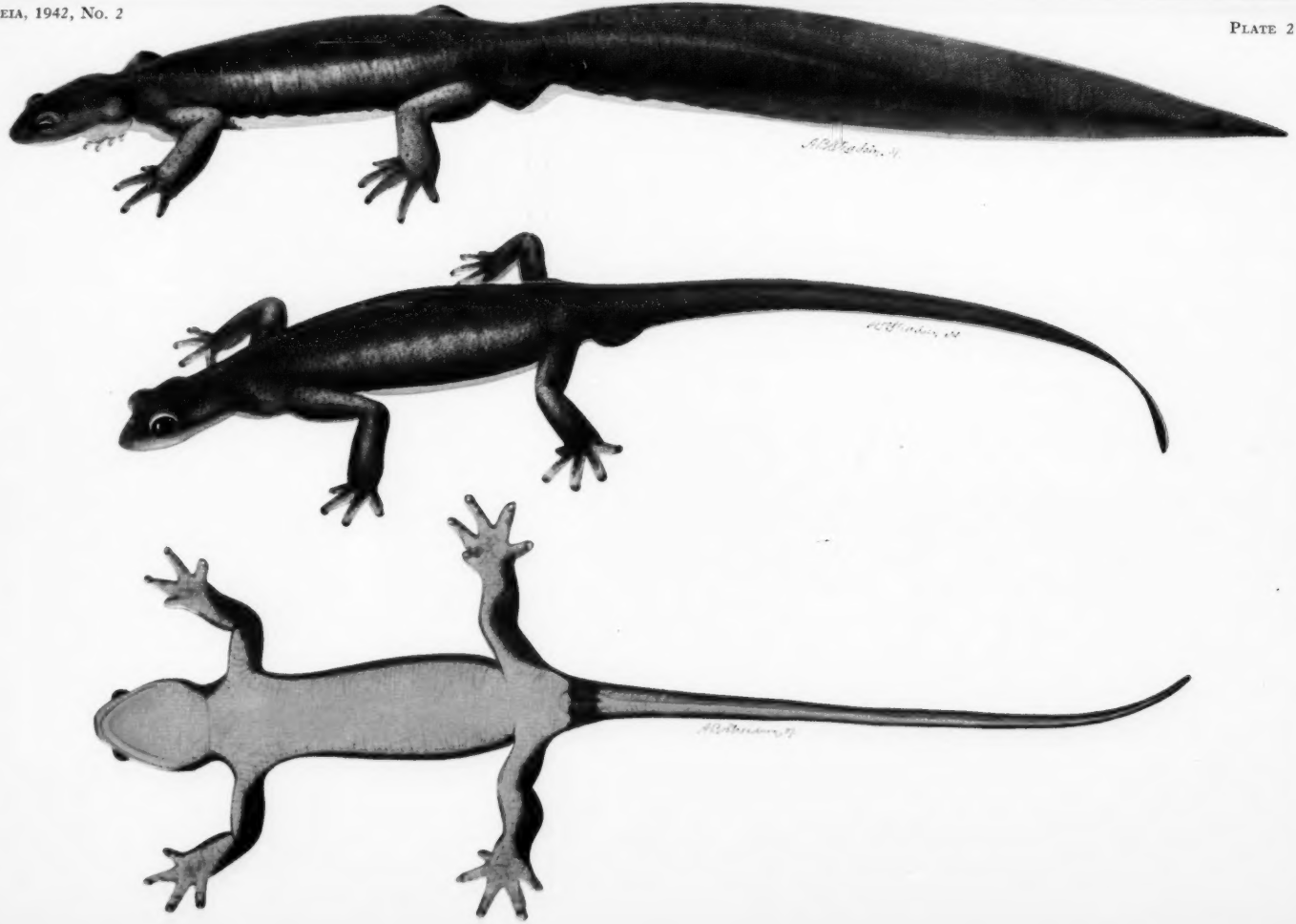
Characteristics uniting all three species include a similarity in general body form, with prominent eyes, pointed snout, and approximately the same pattern of palatine dentition. All deposit their eggs in clusters, instead of singly as in *granulosus*, and the general external form of the female cloaca is also the same (for comparison with *granulosus* in latter respect, see below, and also Plate 3).

My first inclination was to regard *sierrae* as a subspecies of *torosus*, but it proves to be sharply differentiated from the latter, as well as from *rivularis*, and appears deserving of full specific status.

T. rivularis is clearly the most distinctive of the three species in question. The adults are immediately distinguishable by the dark color of the iris (Plate 3). The body form appears to reflect its commitment to the mountain brook habitat for purposes of spawning. The proportions of the body are in general somewhat more slender and graceful, particularly in males, and the tail fin of this sex is less developed during the breeding season than in the other forms. The flattened shape of the egg clusters is suited to the confined spaces in which they are generally deposited, on the under surfaces of stones in swiftly flowing water (Plate 5). Even when the eggs are attached to roots, as happens occasionally when the latter are suitably situated, this characteristic shape of the clusters still persists. Unique also is the absence or incompletely developed condition of the balancer (for photographs, see Twitty,

PLATE 2

Above: adult male of *T. granulosus* from Mendocino County in breeding condition. Extreme development of the tail fin is characteristic of the breeding males in this species. Adult pigmentation is more variable in this than in other species of Californian *Triturus,* and may be either somewhat darker or considerably lighter than in the specimen shown here. The sides of breeding males generally exhibit a characteristic steely-blue coloration (which is, however, sometimes approximated also in *torosus* males). Particularly during terrestrial periods the back and sides of both sexes are often quite dark, almost black, and the belly a yellowish or pinkish orange. In general the *granulosus* of Santa Clara County are less darkly pigmented than those farther north (see Bishop, 1941). ***Middle and below:*** lateral and ventral views of an adult *T. rivularis* female. Note dark dorsal pigmentation, tomato red coloration below, dark color of eye, and extension of black dorsal pigmentation onto the ventral surface of the limbs. The band across the cloaca is very characteristic, but not invariable, and may appear also in lesser degree of development in other Californian species of *Triturus.* All drawings approximately natural size. (All color reproductions are shown in warmer tones than in original drawings. In this plate, original of *T. granulosus* more nearly greenish gray than reproduction, which shows as warm brown; and original of *T. rivularis* more tomato red below than orange, as indicated in plate.)



1936), a condition which for obscure reasons tends to recur frequently in mountain brook representatives of various groups of salamanders. Particularly distinctive is the pattern of larval pigmentation, in which the melanophores are distributed uniformly over the entire sides from the earliest stages (compare with other species in Plate 4).

Triturus granulosus differs from the other species in several well defined respects. The head is blunter and the eyes smaller. An almost infallible means of recognition is provided by the position of the eyes when the head is viewed directly from above (Plate 5). The jaw margin extends laterally below the eye, so that it is not visible in free profile, whereas in the other three species the profile of the larger eye coincides with or partly conceals that of the jaw margin. Another means of identification is the arrangement of the two rows of palatine teeth. In *granulosus* the two rows diverge gradually, in approximately the relationship of the two arms of an inverted letter V, whereas in the other species they lie almost parallel in their anterior extent, followed by an abrupt divergence posteriorly (see fig. 2, Twitty, 1935). The external form of the female cloaca is also distinctive (Plate 3). The lips form an elevated, somewhat laterally compressed cone, with the small vent situated near the apex. In *torosus, rivularis* and *sierrae* the vent is longer, and situated deeper between the more swollen lateral lips (Plate 3). In breeding males the tail fin reaches an extreme degree of development compared with the other species, and likewise often the cloacal lips. Adult pigmentation is somewhat variable, and a full account will not be attempted here. One feature that appears to be characteristic is the sharper demarcation along the sides where the darker pigment of the back meets the lighter coloration of the belly. This is not absolutely diagnostic, however, as a similar condition is sometimes approached in *torosus*.

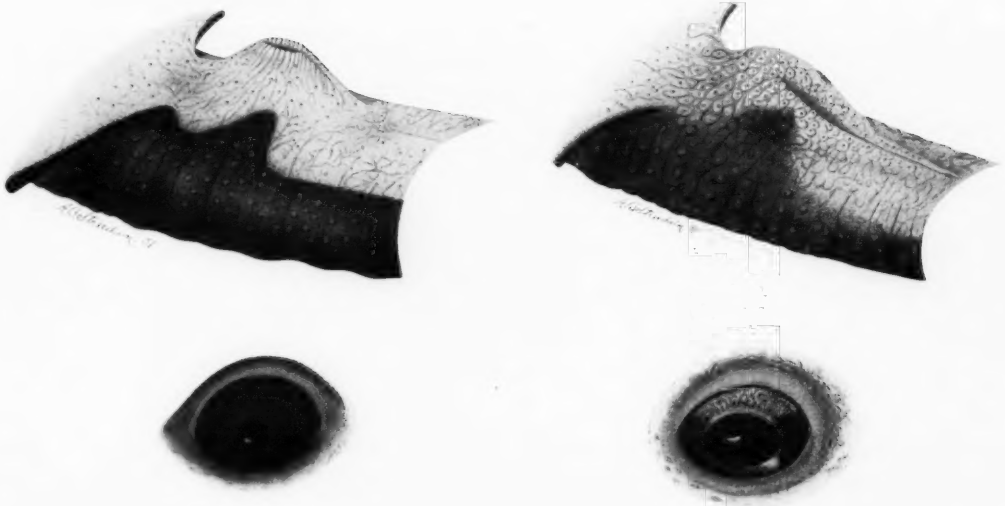
Triturus granulosus appears to show a stronger predilection for spawning in quiet water than any of the other Californian species. Although it may indeed spawn in streams, to my knowledge *granulosus* never elects to deposit its eggs in places exposed to the full sweep of the current as is so often observed in the other species. *Triturus granulosus* is the only one of the Californian species that deposits its eggs singly (Plate 5), a habit which is more in keeping with that of the genus in general (for example, *pyrrhogaster, viridescens,* and the European species). The eggs are also distinctly smaller than those of *torosus, rivularis* and *sierrae,* particularly those of the two latter species (see Plate 5).

It is my guess that *granulosus,* more nearly than any other, represents the primitive or original form of Californian *Triturus*. This is suggested by its vast range (from Alaska to central California, whereas the others are known only in California), the habit of depositing the eggs singly, and the similarity of larval pigmentation to that of other members of the genus outside California. This view is also possibly supported by certain morphological characteristics of the adult, particularly the skeleton, which has been studied comparatively in the four species of *Triturus* by Horsburgh (1938).

Triturus torosus spawns in quiet and rapid water and it is of interest to conjecture which of these choices may represent the more primitive one. I have had occasion, as have many others, to observe the spawning of this

Plate 3

Above, left: anal region of adult female *T. granulosus*. Note crater-like extension of cloacal lips to form conical elevation with vent near apex. *Above, right:* same region in adult *T. torosus* female. Vent longer and more slit-like than in female *granulosus*, situated in depression between somewhat swollen lateral lips. *Below, left:* eye of adult *T. torosus*. *Below, right:* eye of adult *T. torosus*. Iris pigmentation of essentially this character also in *granulosus* and *sierrae*, although in latter generally brighter and more silvery.



species in almost incredible abundance in the completely quiet waters of ponds, where the floor around much of the margin may be almost carpeted with egg clusters. There is no question, therefore, that *torosus* has adapted itself strongly to this particular type of spawning habitat. On the other hand, it has been noted in numerous instances that an even greater concentration, if possible, of spawning adults will accumulate at that point in the pond or lake where it may receive a small stream. At this junction, and extending for a short distance up the tributary, even in extremely shallow currents, adults may congregate and spawn literally in masses. In such instances as this, where the animals have opportunity to manifest a choice, the evidence suggests at least some degree of instinctive preference for flowing water. It is not improbable, in fact, that before ponds and reservoirs were created in the particular areas where such observations have been made (Santa Clara and Mendocino counties), the general paucity of natural bodies of quiet water gave them little choice as to spawning habitat.

The spawning season of *torosus* in Santa Clara County is characterized by two distinct peaks of breeding activity. The first usually begins in late December or early January, after the onset of heavy winter rains, and is confined to ponds and reservoirs or their immediate junction with small feeding streams. Spawning is extremely active at this time, but usually declines by late January or the middle of February. This is followed by a second period of activity, now in streams, initiated as soon as the latter subside from their winter floods and apparently involving a different group of adults. The time of onset naturally varies considerably with the seasonal conditions, but usually lies in March. In one year when the streams remained swollen unusually late in the spring, isolated individuals were still spawning as late as May 1.

Distribution of the Four Species of Californian *Triturus*

A list of specific locality records will not be attempted here, the object of this section being merely to sketch in broad outlines the approximate geographical ranges of the species of *Triturus*.

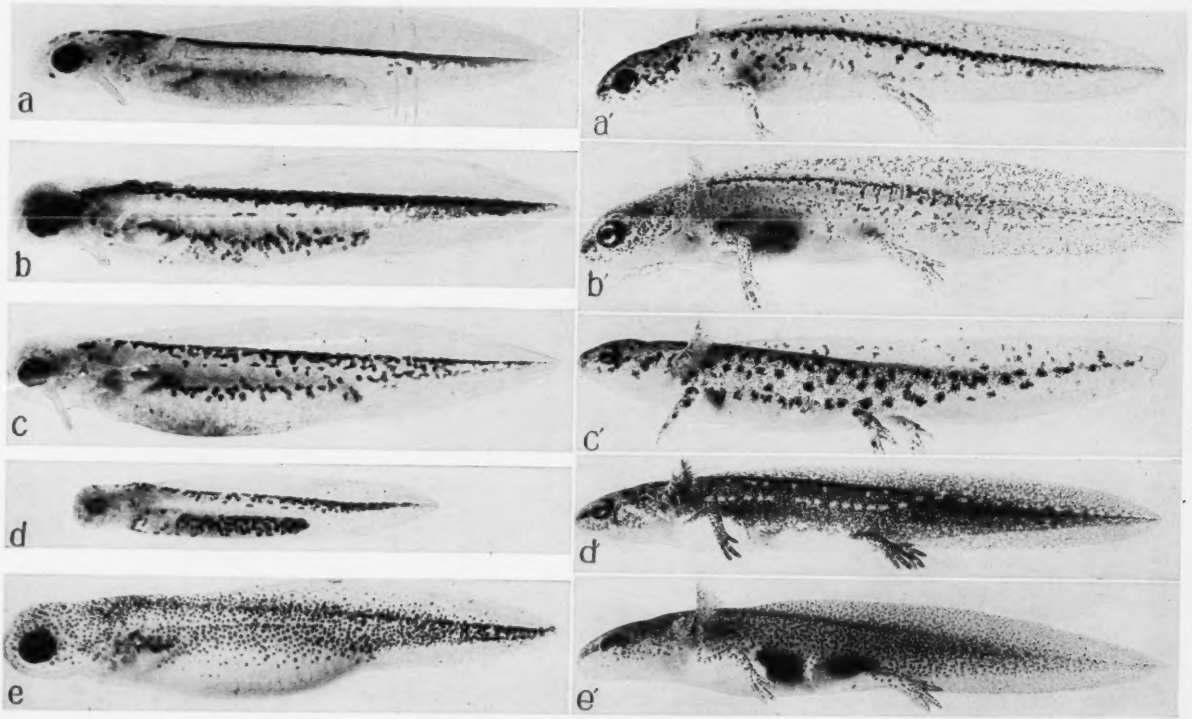
T. granulosus is distributed from central California in the counties of the coastal mountains northward through Oregon (Fitch, 1938), Washington and Canada to Alaska (see Myers, this issue of Copeia). In northern California it apparently extends around the northern end of the Sacramento Valley and southward on its eastern margin at least as far as Chico, where I have collected it together with *T. sierrae*. Insofar as my information extends, *granulosus* does not occur south of Monterey Bay on the California coast. It is common in Santa Clara County, but I have not as yet encountered it on the eastern side of San Francisco Bay in the Mt. Hamilton range, where *torosus* is abundant. It is reported from the vicinity of Berkeley, however, farther north on the eastern side of the bay. For evidence of differentiation within this species, see Bishop (1941), who distinguishes between northern and southern forms, and Myers (this issue of Copeia), who describes material occurring in Crater Lake, Oregon.

The known ranges of the other three species are limited to California.

Triturus torosus is apparently confined to the coastal portions of central

PLATE 4

Illustrating the larval pigmentation of the five forms of Californian *Triturus*. *a, a', T. torosus,* young and old larvae, respectively; *b, b', T. torosus* from the Santa Lucia Mountains, Monterey County; *c, c', T. sierrae*; *d, d', T. granulosus*; *e, e', T. rivularis*.


a
a′
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and northern California, extending northward on both sides of San Francisco Bay from Santa Clara County at least as far as Mendocino County (for *Triturus* of southern California, see below).

T. rivularis is known to occur in three adjacent coastal counties in northern California, Sonoma, Mendocino and Humboldt.

The range of *T. sierrae* has already been identified tentatively with the western Sierran slope, from Butte County southwards to Fresno County.

The *Triturus* of Coastal Southern California

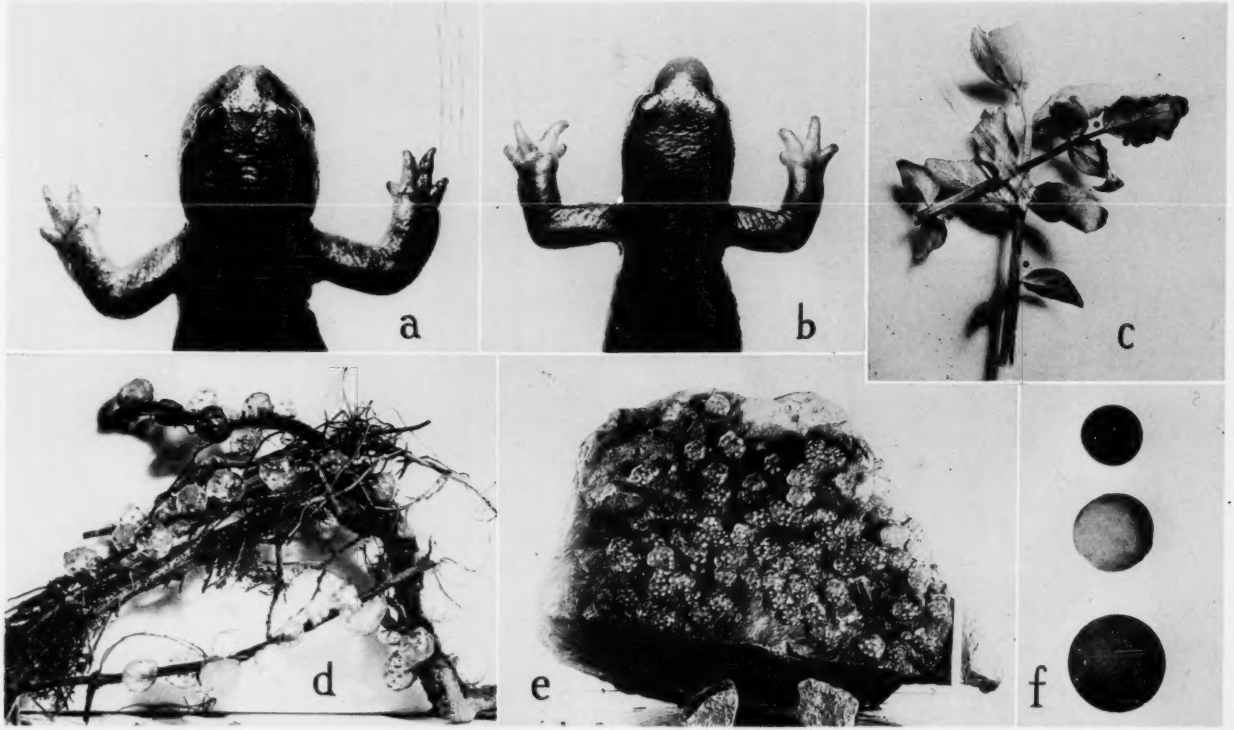
On the basis of material that I have collected or received from three widely separated points along the southern California coast, it appears that the *Triturus* of this area, although clearly "*torosus*," differs somewhat from the latter as known from farther north. The material in question was collected from the valley of the Carmel River, in northern Monterey County; San Antonio River and Arroyo Seco in the Santa Lucia Mountains near "The Indians" in Monterey County west of King City; and from an unrecorded locality near Los Angeles. Although there is no question that this material is genetically distinct from that farther north, the differences known to me at present do not lend themselves readily for purposes of systematic diagnosis, and for this reason I hesitate to designate it as a separate form. My attention was first attracted by the character of the early larval pigmentation. As may be seen in Plate 4, *b*, the sides are much more heavily pigmented than in northern *torosus* (Plate 4, *a*). In the latter, virtually all the melanophores of the young larva are confined to the dorsal bands; and the few that may appear elsewhere on the trunk are invariably limited to a narrow region along the dorsal margin of the yolk mass. In the southern form these flank melanophores are not only much more numerous, but descend farther ventrally on the sides. Differences of this nature are admittedly minor, but from experience I know them to be absolutely distinctive and firmly hereditary in basis.

The form described by Wolterstorff (1935) as *Taricha torosa klauberi* was distinguished principally on account of prominent warty tubercles in the skin of adults. Examination of a particularly warty specimen received from Mr. Klauber shows that the warty condition is due to extreme local proliferation of fibrous connective tissue. Both microscopic appearance in section and external appearance appear to indicate a pathological condition. A female of the same series was induced to ovulate and the eggs were fertilized with sperm from a warty male. The embryos resulting from these eggs are like those of Monterey County specimens in having melanophores on the sides of the yolk mass, though fewer in number and less extended ventrally. The warty condition of the skin, whether pathological or not, has not been observed in Monterey County specimens, though it has been noted in rare instances in specimens from near Palo Alto. Until further differences are found between the Monterey and Los Angeles *Triturus torosus* on one hand and the San Diegan form on the other, it may be proper to refer all *torosus* from the southern coastal region to a single form.

From the foregoing it is seen (omitting further reference to the form just mentioned) that north of Monterey Bay both *torosus* and *granulosus* coexist along the coastal areas of northern California. North of San Francisco Bay,

PLATE 5

a and *b*, dorsal views of heads of adult breeding males of *T. granulosus* and *T. rivularis*, respectively, showing difference in shape, and more prominent position of eyes in the latter species; *c*, eggs of *T. granulosus*, illustrating habit in this species of depositing eggs singly (in this instance eggs deposited during captivity, in large outdoor tank); *d*, egg clusters of *T. torosus* atached to roots taken from a stream on Portola Road near Stanford University; *e*, egg clusters of *T. rivularis*, deposited on under surface of rock taken from creek near Ukiah, California; *f*, photographs showing comparative egg size in the species of Californian *Triturus*. From above to below, *T. granulosus*, *T. torosus*, and *T. rivularis* (eggs of *T. sierrae* of same size as those of *rivularis*).


a
b
c
d
e
f

beginning to our knowledge in Sonoma County, *rivularis* is also represented, making a total of three species occurring together in this general region. On the eastern side of the great central valley *T. sierrae* is the dominant representative, although *granulosus* is also known to occur within at least the extreme northern portion of this range. Uninvestigated as yet, and potentially of considerable interest, are the large areas at the northern and southern ends of the Sacramento-San Joaquin Valley, where the boundaries between the ranges of the typically coastal and the typically Sierran forms will presumably be found.

The *Triturus* in the Vicinity of Ukiah, Mendocino County

As just noted, three species of *Triturus* are known to inhabit the same range in certain of the northern coastal counties. Within this region my own investigations have been confined principally to Mendocino County, and have been most intensive in a limited region around the city of Ukiah. My observations provide striking illustrations of local segregation of species within a small area.

Ukiah is situated in a narrow valley through which flows the Russian River, the latter receiving tributaries from the nearby mountains both to the east and west. During a period of several years frequent observations have been made especially at four or five different sites, mostly in connection with the collection of material for experimental purposes. Two of these are typical mountain brooks, Gibson Creek at the western outskirts of Ukiah, and Robinson Creek perhaps 3 or 4 miles to the southwest of this city. Both *granulosus* and *rivularis*, particularly the latter, are abundant in and near these streams at certain seasons. Adult *rivularis* appear with the first fall or winter rains, but for the most part never enter the water until the streams begin to recede from their winter floods. The males enter the streams considerably earlier than the females, whose stay in the stream is apparently confined to a short period during the actual mating and spawning (principally during April). In fact, soon after spawning is completed, both sexes disappear rather abruptly, not to be seen again until the following fall. *Triturus granulosus* enters the water at about the same time as does *rivularis*, where it elects the quieter portions of the streams. Both species may be seen mating at the same time. Rarely a male of one species has been seen clasping a female of the other, but this act is apparently fortuitous, and does not culminate in insemination. Among the vast number of embryos of both species whose development has been observed in the laboratory, no evidence whatever of natural hybridization has been detected. Unlike *rivularis*, *granulosus* may remain in the water for long periods subsequent to mating and there is virtually no season of the year, except during the period of flood, when adults of this species cannot be found in these streams. *Triturus granulosus* is clearly the most aquatic of the Californian newts. In fact the actual spawning season itself is distributed over a longer period of the year than in the others. Within a given locality, or even in the same body of water, I have found females spawning, or with eggs in the oviducts, from late December until May or June. However, the season of most active spawning appears to lie principally within the months of March and April.

Triturus torosus, on the other hand, has never been observed in or near the two streams in question, or in nearby ones on this same (western) side of the valley that have been visited on occasion. The reasons for this are obscure, since many of the larger pools offer spawning conditions approximating those often chosen by *torosus* in other regions.

The situation on the opposite or eastern side of the valley, possibly 5 or 6 miles distant, offers an interesting comparison with that just described. Most of my observations here have been confined to two adjacent artificial reservoirs (in a canyon near the Ukiah State Hospital), supplied above and emptying below by a small tributary of the Russian River. *T. granulosus* is again present here, in especial abundance, but the companion species is *torosus*. Although portions of the stream would seem suited for *rivularis*, this species is almost entirely absent. Only a single male has been found in the canyon, a conspicuous exception among the literally thousands of *torosus* and *granulosus* adults that have been collected or observed.

At another point about 3 miles approximately north of Ukiah I have collected frequently in a spring-fed pool of small size and dense vegetation, the latter consisting principally of water cress. Here only *granulosus* occurs. It is apparently not unusual for such bodies of water within the immediate range of both *torosus* and *granulosus* to be inhabited only by the latter. An instance in point is apparently provided by a similar pond near Saratoga, in Santa Clara County.

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Notes on Pacific Coast *Triturus*

By George S. Myers

CONSIDERABLE field work on Californian *Triturus* during the last few years, supplemented by examination of living adults in breeding condition from other west coast areas, has given a much clearer picture of the specific and racial distribution of these newts than we had when Twitty first showed that more than one western species exists. The present brief abstract is intended to give my own impression of the present state of our knowledge, based on extensive field work and laboratory examination of these forms, but much more work will be necessary before a really adequate treatment of western *Triturus* can be given.

It must be emphasized that identification of western *Triturus* other than breeding adults is frequently difficult. The general run of museum specimens, consisting of young and half grown examples, and adults taken on land throughout most of the year, many of them not well preserved, are usually of little use. Perhaps, after the natural populations have been more carefully delineated, such material will be of more help, but in my work I have depended heavily upon adequate samples of breeding adults, either alive or very carefully preserved. The specific and racial characters in these individuals are accentuated, and no one who has seen large amounts of such material can doubt the existence of several species and subspecies of western *Triturus*.

I leave the generic allocation of the different west American species in abeyance. Wolterstorff and Herre (1935) place the west American forms in *Taricha*, but they recognized only *torosus*, and in view of the known skeletal differences between the western species I am not inclined to accept their generic splitting until more work has been done. Of the Asiatic genera recognized by Herre and Wolterstorff, by Chang (1936), or by Pope and Boring (1940), I have had at Stanford for comparison only *Tylototriton* (2 species), *Triturus* (2 species), *Hypselotriton*, and *Paramesotriton*. Of these, our western forms are superficially similar only to the second and fourth. They are certainly closer to these than to most of the European forms, or to *viridescens*.

For their great kindness in sending me live or fresh breeding specimens, especial thanks are due to: Mr. Vincent Boucher, of Gravina Island, opposite Ketchikan, Alaska; Prof. J. R. Slater, College of Puget Sound, Tacoma, Washington; Dr. James P. Heath, who sent the Crater Lake material; and Dr. L. M. Klauber, of San Diego. Prof. Twitty has allowed free use of the thousands of *Triturus* that pass through his laboratory annually, and has turned over many specimens to the Museum. I have gone with him to his chief collecting localities, and had the advantage of his opinion on all matters relating to these animals. Responsibility for the conclusions exercised herein, is however, my own.

My investigations on museum material have been confined to that present in the Natural History Museum of Stanford University, which now consists of a thousand or more western *Triturus*. My range statements are usually based exclusively on this material and may therefore be modified by specimens present in other museums.

1. *Triturus granulosus*

This is the most widespread and most protean species. It ranges from Admiralty Island, Alaska, southward through transmontane Washington and Oregon at least to the Sierra foothills of Butte County, California, and along the coastal ranges to Santa Cruz County, California.

The best character for the recognition of *granulosus* in the field is the small eye. Once one has become familiar with the appearance and size of the eye, failure to recognize adults in either the field or the laboratory is rare, but the character is more difficult to apply to young individuals. In breeding females, the peculiarly raised, lip-like structure of the cloacal aperture is absolutely diagnostic. The diverging palatine teeth well described by Twitty, are usually sufficient for identification, but are subject to some variation. The larvae are distinctive, but have been sufficiently described by Twitty.

Bishop (1941) has distinguished the southwesternmost California coastal population as a distinct subspecies, *T. g. twittyi*, characterized by the lesser area of pigmentation on the legs and the average larger size. He places the area of intergradation in Marin, Napa, and southern Mendocino counties, California, and refers the more northerly populations to *T. g. granulosus*. The situation is actually not so simple. If we are to recognize subspecies within *granulosus* at all, at least four must be set up. These four have all been noted by Dr. Twitty and myself in the material that has passed through our hands. The exact limits of their ranges have not, as yet, been adequately determined, and the forms cannot at present be as succinctly defined as one might wish, but since one of them has already been recognized nomenclaturally, and the others seem just as well marked, the following arrangement is proposed:

1a. *Triturus granulosus twittyi* Bishop

Type Locality.—Saratoga, Santa Clara County, California.

Range.—Coast Range of Santa Cruz and central Santa Clara counties north to Napa, Marin, and southern Mendocino counties, California.

Diagnostic Characters.—A large *Triturus* with the dorsal dark pigment running scarcely below the midline of the sides and the light ventral color usually reaching the tail tip; in the breeding season the dorsum is distinctly brownish and the males show neither the excessively spongy skin nor the excessively deep caudal fins and brilliant neutral color of the adjoining northern race.

Remarks.—This is not, as one would gather from Bishop's description, the largest race of *granulosus*. Occasional breeding males approach *similans* in the dull Oxford gray or blackish dorsum and in the excessively smooth, spongy skin, but I have seen no such constant development of these characters as one finds in nearly all the breeding males of *similans*.

1b. *Triturus granulosus similans* Twitty

TYPE LOCALITY.—Robinson Creek, Ukiah, Mendocino County, California.

RANGE.—Known from good breeding samples only from the vicinity of the type locality and of Chico, Butte County, California. From other materials examined this subspecies would appear to range from the area of intergradation with *twittyi* north through the coast ranges and Sierra at least to the Klamath River and the Siskiyous, but the area of intergradation with *granulosus granulosus* is not known.

DIAGNOSTIC CHARACTERS.—The largest of the races of *granulosus*. Eleven large males taken at random from two lots (Nos. 2380–2400, Ukiah; 2468–2490, Butte County) run from 163 to 206 mm. total length, average 174. Dorsal dark pigment running considerably below middle of sides, and usually entirely crowding out the light ventral color near tip of tail. Skin of breeding males very smooth and spongy. The dorsal color of breeding examples is a slate gray to Oxford gray to almost black, the sharp border between the dorsal and ventral colors (usually a good specific character for *granulosus*) even more sharply defined than in other races. Caudal fin of breeding males broader than in other races, though approached most closely by *twittyi*. Venter of breeding examples a more brilliant (and more opaque) yellow than in other races, varying from near canary to orange yellow.

DISCUSSION.—This is, in coloration, soft breeding skin, and size, the most "highly developed" race of *granulosus*, the difference between breeding colonies of *similans* and of *twittyi* being striking.

1c. *Triturus granulosus granulosus* (Skilton)

TYPE LOCALITY.—Probably vicinity of Oregon City, Clackamas County, Oregon (see Fitch, 1938).

RANGE.—Probably from near the northern boundary of California northward through transmontane Oregon, Washington, and British Columbia to Admiralty Island, Alaska.

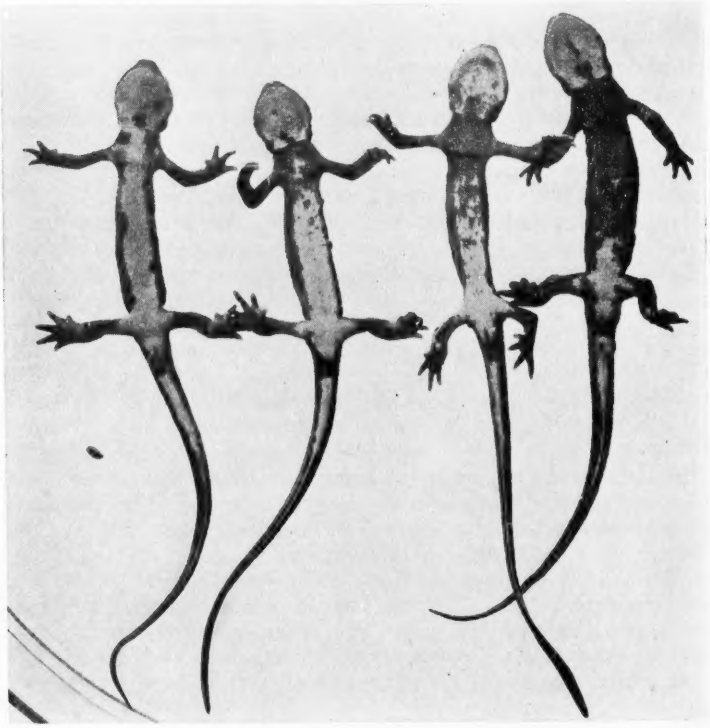
DIAGNOSTIC CHARACTERS.—Generally considerably smaller than either *twittyi* or *similans*. Eleven large males of a lot from Fox Island, near Tacoma, Washington (Nos. 6463–6482), run from 146 to 168 mm. total length, average 155. Dorsal dark pigment running considerably below middle of sides, and usually crowding out the light ventral color near the tip of the tail. Dorsal coloration of breeding examples browner than in *similans*, and the males with smooth and spongy skin. Caudal fin of breeding males less elevated than in *similans*, rather similar to *twittyi*. Venter of breeding specimens less brilliant than in *similans*, and without dark clouding except in some far northern examples.

DISCUSSION.—This race apparently forms the main body of the species, probably contains many local populations differing rather widely from each other, and is therefore harder to define than its southern segregates. The average size decreases to the northward and no Alaskan examples I have seen approach the size of Puget Sound adults. A fine breeding series collected by Mr. Boucher on Gravina Island, opposite Ketchikan (Nos. 4488–4508), is remarkable in the variable but often heavy dark clouding and mottling of the belly and throat. Our examples from Olive Cove and Lake McDonald

show no such clouding, nor do examples from Coon Cove, George's Inlet,[1] from Admiralty Island,[1] from Vancouver Island,[1] and from the British Columbia mainland.[1] The Gravina specimens, however, have the ventral clouding lighter than the Crater Lake subspecies, and the breeding males have the higher caudal fin typical of *g. granulosus*.

1d. *Triturus granulosus* ***mazamae***, new subspecies

TYPE.—Stanford Amphib. Cat. No. 7465, an adult male, 70 mm. in length to cloaca, total length 170 mm., collected near Crater Lake on the higher slopes of Mt. Mazama, Crater Lake National Park, Klamath County, Oregon, in the summer of 1938, by Dr. James P. Heath.



Ventral aspect of *Triturus granulosus mazamae* from Crater Lake. Left to right: Stanford 7466, 7472, 7471, 7465 (type).

PARATYPES.—Stanford 3880–3900, 7463–7464, 7466–7479, same data as type; also five uncatalogued specimens in the Museum of Vertebrate

[1] These lots are in the Museum of Vertebrate Zoology and were lent me through the courtesy of Mr. Thomas Rodgers.

Zoology, collected at Eagle Cove (alt. 6166 ft.), Crater Lake, Aug. 1, 1936, by J. S. Brode.

RANGE.—So far as known only the slopes of Mt. Mazama (in the crater of which lies Crater Lake) but presumably also ranging northward at higher altitudes in the Cascades.

DIAGNOSTIC CHARACTERS.—A medium-sized form similar in nearly all characteristics to *T. granulosus granulosus* but differing in the very slight development of the dorsal and ventral caudal fins of breeding males, in the longer tail, in the blackish color of the dorsum, and in the presence in adults of a heavy suffusion of the undersurfaces with the blackish pigment of the dorsum. This suffusion is little developed in newly transformed or half grown examples but all of the adults I have seen show some trace of it. The most constant parts of the ventral dark suffusion involve the undersurfaces of the arms, which are usually almost or entirely dark beneath, and the dark invasion of each side of the breast just before the arms. All of the specimens show these characters, and most of them have the entire pectoral region black or black-spotted, as well as black or nearly black undersurfaces of the hind limbs. Most have a black band across the cloaca. The black of the pectoral region usually invades the throat and belly, and is best developed in No. 7467, which is all black below except for a smudgy light area about the cloaca and lower pelvic area and a light suffusion on the throat.

DISCUSSION.—The forty-three Crater Lake specimens examined form a coherent and easily recognized sample. I know of dark bellied *granulosus* elsewhere only from Gravina Island, Alaska, and they differ from *mazamae* in the more usual, better developed caudal fins and shorter tails of the males; the much paler color of the ventral marbling, and its presence in a much smaller percentage of the sample; in the usually light undersurface of the arms; and in the slightly more projecting snout. If the Gravina specimens really represent a distinct race, its characters are not as well marked as those of *mazamae*.

2. *Triturus rivularis* Twitty

TYPE LOCALITY.—Gibson Creek, about one mile west of Ukiah, Mendocino County, California.

RANGE.—We have specimens of *rivularis* only from the vicinity of Ukiah, and from Honeydew, Humboldt Co., California (Nos. 3301–3305, coll. Leo Shapovalov). The species extends southward into Sonoma County, and probably northward to Del Norte County. It appears to be confined to the Coast Range redwood belt.

REMARKS.—This is a very distinctive species, and in life it is quite impossible to mistake it.

3. *Triturus sierrae* Twitty

TYPE LOCALITY.—Cherokee Creek, Butte County, California.

RANGE.—Lower western slopes of the Sierra Nevada, from Butte County to Fresno County, California.

REMARKS.—This species is described in the preceding paper by Dr. Twitty.

4. *Triturus torosus* (Rathke)

TYPE LOCALITY.—Surroundings of the bay of San Francisco, California.

RANGE.—Vicinity of Ukiah, Mendocino County, California, southward to northernmost Baja California, Mexico.

REMARKS.—This species exhibits numerous local races, but none of them seems at present to be worthy of nomenclatural recognition. Dr. Twitty has called attention to slight differences in the larval pigmentation of the examples taken in the Carmel River, Monterey County, and to the southward in the Santa Lucia Mountains. If this form is ever recognized subspecifically, the name *beecheyi* Gray, 1839, type locality Monterey, Monterey County, is available for it.

Both Dr. Twitty and I have taken great interest in a fine series of live breeding adults sent to us by Dr. Klauber. They are from Boulder Creek, San Diego County, the type locality of *klauberi* Wolterstorff. The newts show the peculiar lumpy skin and short muzzle supposedly characteristic of *klauberi*, but a number of the individuals show little trace of the peculiarity. The less "lumpy" individuals show a normal muzzle and I believe the short snout and lumps to be correlated. Although skin sections made by Dr. Twitty show no parasitism we both feel that the lumpy condition and other supposed characters of *klauberi* strongly indicate a pathological condition which increases with age, and for the time being I do not think that *klauberi* should be recognized.

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Summary Food of *Chrysemys picta marginata*, in Chautauqua Lake, New York

By Edward C. Raney and Ernest A. Lachner

NINETY specimens of the central painted turtle, *Chrysemys picta marginata* (Agassiz), were captured during the period from August 17 to 29, 1941, in three trap nets of the New York Conservation Department, located just north of Stow and at Prendergast Point, Chautauqua Lake, Chautauqua County, New York. The nets were set in water from 5 to 8 feet deep over weed beds consisting largely of waterweed, *Anacharis canadensis*, yellow water lily, *Nuphar variegatum*, and several species of *Potamogeton*. These nets were lifted and reset daily at 8 to 10 A.M. The turtles were killed immediately and after the plastrons were removed they were preserved in 10 per cent formalin. All 90 specimens were adults (62 males and 28 females) and ranged in length of carapace from 106 to 175 mm., with a mean of 135.6 (standard deviation 14.7). The stomachs of 76 (55 males and 21 females) contained food, while 14 were empty.

Each stomach was considered as a unit in the estimates of the percentage by volume occupied by each food item. An exploratory attempt at estimating the relative volume of the different organisms in the intestines indicated that large errors would result because of more rapid digestion of certain animal tissues, such as large soft-bodied insects. Furthermore, since no organisms were found in the intestines which were not found in at least one of the stomachs, only the stomach contents were considered. These data on stomach contents are analyzed in Table I. They supplement the studies of Surface (1908), Pearse, Lepkovsky and Hintze (1925), and Lagler (1941), made in Pennsylvania, Wisconsin, and Michigan on *Chrysemys picta marginata, C. picta picta, C. picta belli*, or intergrades of these subspecies.

When percentage by volume is considered, the food items were about equally divided between plants and animals. However, 15 more stomachs contained animal material than plants, and only one of the 76 stomachs held no animal food. Of the animals eaten, snails were most abundant (16 per cent). The most common species were *Amnicola limosa, Physa heterostropha, Valvata tricarinata*, and *Heliosoma campanulatus*. An occasional snail was undoubtedly engulfed incidentally with plants, but in many stomachs the snails occupied a much greater volume than the plants. Even when plants were present, they were usually separated from the snails in a manner which suggested that they were probably eaten at different times. About 14 per cent of the volume was fishes. Of the four individual game and pan fishes that were eaten, three were yellow perch, *Perca flavescens*, and one was a young largemouth bass, *Huro salmoides*. These were swallowed whole. Two of the three forage fish taken were the spottail shiner, *Notropis h. hudsonius*, while the third was also a cyprinid. Considerable fish carrion was engulfed and was easily recognized in the stomach by the semi-solid irregular mixture of flesh and bone. Insects occupied 11.6 per cent by volume. The only three

orders of importance were Diptera, Trichoptera, and Coleoptera. Most Diptera were adult *Chironomus* and practically all the Diptera larvae were of the same family. A number of Trichoptera (Limnephilidae) were eaten, some of the time at least, because they had used leaves of *Anacharis* as a case making material. Since *Anacharis* alone made up 16.6 per cent of the stomach contents, it seems that what might otherwise have been a protectively colored covering for the Trichoptera had not given protection merely because the background material was eaten in bulk. Twelve crayfish were eaten, while only three small Amphipoda were taken. Three statoblasts of a bryozoan, *Pectinatella*, were eaten. One small water mite was engulfed.

A slightly greater amount of algae than of vascular plants was found

TABLE I

The stomach contents of 76 adult central painted turtles, *Chrysemys picta marginata* (Agassiz), taken in Chautauqua Lake, New York, from August 17 to 29, 1941.

Food item	No. of stomachs containing item	Percentage of stomachs containing item	Total number of the item found in all stomachs	Percentage by volume
Animal	75	98.7	...	51.6
Snails	35	46.1	...	15.9
Amnicola	27	35.5	879	10.2
Physa	7	9.2	113	4.1
Valvata	8	10.5	24	0.2
Other species and remains	9	11.8	...	1.4
Fishes	24	31.6	...	13.8
Game and pan	4	5.3	4	3.2
Forage fish	3	3.9	3	3.7
Remains and carrion	17	22.4	...	6.9
Insects	49	64.5	...	11.6
Diptera	36	47.4	392	7.1
Trichoptera	19	25.0	39	3.5
Coleoptera	9	11.8	23	0.5
Odonata	4	5.3	4	0.4
Other orders and remains	8	10.5	...	0.1
Crayfish	12	15.8	12	8.6
Earthworm	1	1.3	1	1.2
Misc. animals*	8	10.5	...	0.5
Plant	60	78.9	...	48.4
Algae	36	47.4	...	25.6
Vascular plants	55	72.4	...	22.8
Anacharis canadensis leaves and stems	42	55.3	...	16.6
Stems	26	34.2	...	5.7
Nuphar seeds	3	3.9	...	0.5

* Includes Amphipoda, Arachnida, *Pectinatella* and unidentified parts.

(Table I). The algae were virtually all filamentous types of the genera *Spirogyra, Oedogonium,* and *Rhizoclonium.* Of the vascular plant food the leaves and leaf buds on the ends of *Anacharis canadesis* stems were commonly eaten. Stems of *Anacharis, Potamogeton,* and other aquatic plants were also eaten. Three turtles were completely filled with pieces of *Anacharis* stems cut quite regularly in lengths of about one-half inch. Large seeds of *Nuphar variegatum* were found in three stomachs. These same seeds were found in the lower intestine of practically all the turtles, and although they appear to

be eaten often, they are probably not digested to any appreciable extent. A total of 67 specimens of a large spiruroid nematode, *Spiroxys contorta,* were found in the stomachs of 33 turtles.

In summary, it is obvious that painted turtles eat a few young game and pan fishes, as well as forage fishes, and also eat such food as insects, snails, and crayfish which may also be eaten by fishes. However, we doubt if they offer serious competition to desirable fish life in Chautauqua Lake, since the type of food taken is probably seldom the limiting factor affecting fish production in weedy situations where these turtles usually are found. They serve a useful purpose as scavengers.

We wish to thank the following persons for checking the identification of certain specimens; Dr. Walter C. Muenscher, plants; Dr. William Marcus Ingram, snails; and Dr. J. T. Lucker, parasitic worms.

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Notes on *Masticophis mentovarius*

By Hobart M. Smith

In Ortenburger's monograph on the whip snakes, the range of *Masticophis mentovarius* is stated to be "From Oaxaca east into Yucatán and south through Guatemala" (1928: 140). Dunn and Emlen (1932: 32) extended the range to Honduras, listing a specimen from San Pedro Sula (MCZ). A year later Dunn (1933: 214) pointed out that *mentovarius* ranges much more widely in Central America than Ortenburger believed, and listed three museum specimens: "Managua, Nicaragua (U.S.N.M. No. 79961); La Palma, Costa Rica (B.M.N.H. No. 1913–7–19–145); Panamá, no specific locality (U.S.N.M. No. 53626, Colegio La Salle)." Later, Dunn recorded the first specimen with definite locality from Panamá (Parita), and added that the range of the species is known to be from Mexico to Venezuela (1940: 118).

The South American record referred to by Dunn is the type of *Spilotes corais suborbitalis* Peters (1868: 641), from Caracas, Venezuela. This was placed in the synonymy of *mentovarius* by Boulenger (1893: 389), but was rejected by Ortenburger (*op. cit.*) and was recently included in the synonymy of *Drymarchon corais* by myself (1941: 472). That Peters erred in supposing his specimen represented a variety of *Spilotes* (= *Drymarchon*) cannot be a certainty until the type is re-examined, since the description is very brief, but that Boulenger was probably right in considering it *mentovarius* (because of the peculiar fusion of the two subocular labials, characteristic of that

species) is indicated by the discovery of the species in practically all the Central American republics.

Added evidence in support of Boulenger's conclusion is another specimen from South America, the second known from that continent and apparently the first from Colombia. It is a juvenile measuring 445 mm. in total length (tail 115 mm.), collected by Dr. Alexander Wetmore on April 16, 1941, at Maicao (USNM). It was taken from the crop of a hawk, *Buteo albicaudatus colonus*. This specimen is a male with 17-17-12 scale rows, 192 ventrals, 119 caudals, 7-7 supralabials, 9-10 infralabials, and 2-2 preoculars and temporals. Not only is the specimen of interest for its distributional data, but also because of its somewhat peculiar coloration.

As noted by Hartweg and Oliver (1940: 19–20) the juveniles of northern *mentovarius* have distinct, lateral longitudinal light stripes on the anterior part of the body. Two specimens cited by them, from Campeche and the vicinity of Tehuantepec, Oaxaca; one from Rodriguez Clara, Veracruz (EHT-HMS 5394); and half-grown specimens from the vicinity of Tehuantepec demonstrate conclusively that the striped condition is normal in subadults.

The specimen from Colombia, however, even though very small, entirely lacks any evidence of differentiated lateral light lines such as are exhibited by northern specimens, and in their stead has narrow, transverse dark spots extending on each side about to the fourth scale row. These spots are well defined anteriorly, but become less distinct and narrow posteriorly and are not visible on the posterior fourth of the body. The juvenile specimen from "Panamá" (392 mm. total length, tail 94 mm.; female with 201 ventrals and 99 caudals) is so very badly faded that the pattern is practically invisible, but there remains faint evidence of cross bands anteriorly, as in the Colombia specimen, and no evidence whatever of distinctive lateral stripes. The half-grown specimen from Nicaragua, however, shows clear evidence of lateral light stripes anteriorly and is certainly indistinguishable from northern *mentovarius* of comparable size. Managua is on the Pacific slopes, as are all other definite localities from which *mentovarius* is known in Central America south of Honduras. In other words the species apparently skips from the northern, Atlantic slopes of South America to the Pacific side of Central America, where it consistently avoids Atlantic exposures except perhaps in part of Panamá (the "Panamá" specimen?) and from Honduras northward. The population on the Atlantic slopes in northern Central America, as evidenced by several locality records from Guatemala and Honduras, has arrived there by radiation from the north, where the species commonly occurs on the Atlantic side, and very likely has no connection with the Atlantic coast population of South America. In most areas this distributional pattern corresponds with regions of relatively little rainfall.

In view of the pattern peculiarities of the Colombia juvenile, as well as the somewhat disconnected position of the South American population, it is suggested that Peters' name be revived for the southern race, *Masticophis mentovarius suborbitalis*. Unfortunately, whether the coloration of the adults of the two races may bear out the differences apparent in the juveniles is not now certain, since adults of *suborbitalis* have not been described, and significant differences in scutellation are not evident. The genus, however,

is notoriously constant in scutellation, no closely related forms being satisfactorily distinguishable in this respect.

The significance of juvenile pattern has been stressed by Ortenburger (*op. cit.*) and discussed further by Hartweg and Oliver (*loc. cit.*). The fact that striped juveniles are the rule in *m. mentovarius* has, in fact, led me to postulate that *mentovarius* is ancestral to the other, striped forms of the genus. A close relationship (ancestral) with *striolatus* also was postulated, although the banded juveniles and presence of the usual two subocular labials in the latter species precluded assumption of such a close relationship as apparently exists between *bilineatus* and *mentovarius*. The fact that the

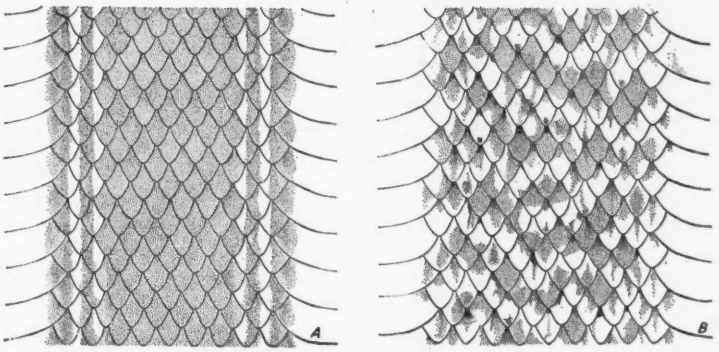

Fig.1. Pattern of anterior part of body of juvenile *Masticophis mentovarius*, from about the 21st to the 29th ventral. A, *Masticophis m. mentovarius*, EHT-HMS No. 5394, Rodriguez Clara, Veracruz. B, *Masticophis m. suborbitalis*, USNM No. 115107, Maicao, Colombia.

southern derivative, *m. suborbitalis*, of *m. mentovarius* has replaced the striped pattern of the latter by a banded pattern, gives an added support to the belief that the banded species (*striolatus*) bordering *m. mentovarius* on the north very probably also was derived from the striped race. The connections between the various species and subspecies of *Masticophis* accordingly are quite apparent. This genus is obviously a natural group. It is composed of many forms dispersed over a wide area which in turn covers much of the range of the disputed genus *Coluber*, with which many authors associate the species of *Masticophis*. These two genera may have had a common origin (as have many distinct snake genera), but it is practically indisputable that they have not intermingled during the ages when the numerous species and races of *Masticophis* were differentiated, and that *Coluber* can now form no part whatever in the phylogenetic scheme of *Masticophis*. That the snakes included in these two genera form natural, sufficiently easily recognizable and convenient assemblages is reason enough for retention of both categories.

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The Status of the Black Whip Snake

By L. M. KLAUBER

INTRODUCTION

IN his comprehensive monograph on the racers, Dr. A. I. Ortenburger, in 1928, concluded that the black whip snake, *Coluber piceus*, is a species separate from the red whip snake or racer, *Coluber flagellum frenatus*, and this decision has usually been followed by subsequent authors, including the writer (1931: 37–38).[1] Having lately had access to a considerable number of new specimens which have invited a review of Ortenburger's findings I have now come to an opposite conclusion, to the effect that the black whip snake is only a local color variant of the red.[2] Since there appears to be no area in which the black form is found alone, it can hardly be considered a valid subspecies. Instead, the reds and blacks should be viewed as a single subspecies, *Coluber flagellum piceus* (Cope), 1875; for *piceus* takes precedence over *frenatus* (Stejneger), 1893. I shall, in this discussion, continue to use the terms *piceus* and *frenatus* as a convenient means of differentiating the black and the red phases, referred to also as the black racer and the red.

A few words of explanation on the geographical situation are in order. The red racer occurs in Lower California, in central and southern California, southwestern Nevada, southwestern Utah, Arizona, Sonora, and various islands in the Gulf of California and on the Pacific coast of Lower California. The black form is much more restricted, being found at scattered points in Lower California, southern San Diego County, California, south-central Arizona,

[1] Ortenburger assigned *piceus* and *frenatus* to the genus *Masticophis*. The validity of this genus is a phase of the problem not here under discussion.

[2] Subsequent to the completion of this paper I received one by Dr. Hobart M. Smith in which he expresses the same opinion (*Journ. Wash. Acad. Sci.* 31. 1941: 388-398).

and Sonora. Thus its range appears as a series of black islands in the red area. So far as is known, there is no area in which the black whip snake occurs wherein the red racer is absent, although there are several in which the blacks outnumber the reds. On the other hand, there are large areas inhabited by *frenatus* where *piceus* is not found. Even in Lower California, where *piceus* is most widespread, its range does not appear to be continuous.

Even this statement of the situation is rather oversimplified, for it is sometimes quite difficult to assign specimens to one classification or the other, since the one form is not always red nor the other all black. The *frenatus* form, in areas quite distant from those occupied by *piceus,* exhibits great variation in color and pattern; it often has a black patch on the neck, with or without light cross bands; and the body may be white, yellow, gray, brown, pink, or red, often with longitudinal streaks. Some of the lightest specimens have black-edged scales; in the Cape region of Lower California, the most common colors are white, yellow, or light-gray, with black-edged scales scattered about. In other areas, even where typical *piceus* is not found, there are dark brown specimens closely approaching the lightest specimens of *piceus;* and in every locality where the black snakes do occur, some individuals are found about mid-way in color between the reds and blacks. This is true both at the centers of the black islands (example, Tucson) and on the peripheries of such areas (example, southern San Diego County). And even the blackest specimens of the black form in the Tucson area, where *piceus* seems purest, are often pink or brown laterally and posteriorly, and are always light (usually pink) on the underside of the body, especially toward the tail. Lower California specimens are more often cream or yellow below, rather than pink.

Resurvey of Differences

Forms which occupy the same territory require at least two coincident differences for the proof of distinction, unless a single character entails a very wide separation without overlapping. Since the colors of these racers do overlap, other character differences are necessary if the black snake is to be considered a valid species. Ortenburger differentiated the two forms on the following characters besides color: *piceus* is stouter and larger (p. 127); there is a difference in habits (pp. 119 and 128); *piceus* has a higher subcaudal scale count (pp. 131 and 133); and there is a difference in proportionate tail-length (p. 133). But it appears that all of these differences fail to hold in data accumulated from recent field observations and the larger preserved series now available.

With reference to size, taking into account only the areas wherein both color phases occur, we have the following size records, the figures being given in millimeters:

	Red	Black
Southern Lower California	1845*	1534
Central Lower California	1457	1227
Northern Lower California	1455*	1620
Coastal San Diego County	1539*	1541*
Central Arizona	1623*	1652†
Sonora	1810*‡	1468*‡

* Tail incomplete.
† Ortenburger mentions one 5 ft. 8 in. (1728 mm.).
‡ Figures from Taylor, 1938.

In several of these groups, especially those having maxima below 1500 mm., there were insufficient specimens to indicate, even approximately, the true size reached; for the larger the series available, the longer the largest specimen is likely to be. I do not consider the figures shown in these tables to be particularly conclusive respecting the length ultimately reached by these snakes in any area, which, I suspect, is close to 1900 mm.; but these records do fail to indicate that the black snakes are conspicuously larger than the red. Nor is there any apparent difference in bulk for a given length.[3]

With respect to habits, Ortenburger observed, while collecting near Tucson, that *frenatus* is at home in the bushes, often seeking refuge in the branches when pursued; but only two *piceus* out of some 20 were in bushes, and none took to a bush when frightened, all escaping into ground holes. It is unquestionably true that the red racer often makes an arboreal escape, but the same is true of the black racer as well; evidently those watched by Ortenburger happened to seek holes. For example, J. R. Slevin disturbed a black pair mating, and both took refuge in the top of a willow tree some 20 feet high (Van Denburgh and Slevin, 1913: 416). Lee W. Arnold, who recently covered a certain route in the Tucson area regularly during two summers for the purpose of making field observations on reptiles, reports: "I have never seen *piceus* in the branches of shrubs—but for that matter, I have never seen it make for a hole or small burrow. Most of the individuals that I have pursued have travelled from bush to bush with great speed until reaching a thicket through which I could not follow." Dr. E. H. Taylor (1938: 490) wrote, in referring to *piceus*: "These specimens seem to be common in the trees along small ravines, at least eight specimens seen escaped into holes in the boles or branches." An ornithologist told me of a *piceus* found 25 feet high in a mesquite tree, robbing a woodpecker's nest. I have seen both red and black racers in fields and chaparral in northern Lower California, and did not observe any differences in their habits. I conclude that the black whip snake is by no means exclusively a ground dweller.

With reference to the characters of subcaudal scale counts and proportionate tail lengths I find no significant differences between the two color phases, as shown in the data which follow. Unfortunately these characters are particularly unsatisfactory criteria in the whip snakes, for they have such slender tails that a large percentage (over half at least) have lost portions of their tails and thus yield no pertinent information. Furthermore, these snakes do not seem to have a characteristic terminal cone, such as is present in many genera, so it is virtually impossible to tell whether a tail is really complete or not. Even a recently hatched brood failed to disclose any uniformity in the shape or size of the terminal spine. Hence, in the statistics which have been accumulated, the subcaudals and tail ratios are subject to considerable doubt. Without question some specimens have been included whose tails are not quite complete; I can only hope that the reds and blacks have been equally affected. In addition, the material must be segregated to avoid territorial, sexual, and ontogenetic unbalance in the samples, for there are group divergences in these characters. For example, Cape region snakes have

[3] If one has before him larger and smaller specimens of one form of snake, the larger will often seem to have the stouter habitus, for some snakes do become relatively more bulky with age (Klauber, 1937: 41).

more subcaudals than those from San Diego County; adults have proportionately longer tails than juveniles; and males have more subcaudals (to a slight extent at least) than females. Thus if heterogeneous groups are compared to demonstrate differences between color phases, and there are, for example, proportionately more Cape specimens in the black sample and more Arizona specimens in the red, the blacks will seem to have more subcaudals than the reds. This necessity for dealing only with segregated and homogeneous groups, as well as the elimination of specimens with incomplete tails, renders the material somewhat inadequate, even though a total of 199 reds and 96 blacks is now available, to say nothing of many other reds from territories where *piceus* does not occur. However, the sexual difference in tail-length proportion is so small (I am not sure yet which sex has the longer tail) that the sexes can be combined in considering this character. I also find it desirable to combine, territorially, the specimens from central Lower California northward to coastal San Diego County, notwithstanding the evidence of minor territorial variations, otherwise the specimens in each group are too few to be useful. The statistics of these caudal characters are summarized below:

SUBCAUDAL SCALE COUNTS

		frenatus		*piceus*	
AREA	SEX	NUMBER OF SPECIMENS	MEAN SUBCAUDALS	NUMBER OF SPECIMENS	MEAN SUBCAUDALS
Cape Region	Male	17	119.94	2	115.50
Central Lower California to Coastal San Diego County	Male	19	113.63	11	116.55
South-central Arizona	Male	8	108.75	7	110.57
Cape Region	Female	18	113.72	5	113.20
Central Lower California to Coastal San Diego County	Female	24	111.79	17	112.71
South-central Arizona	Female	2	105.00	5	106.20

TAIL PROPORTIONALITY
(Adults only)

AREA	NUMBER OF SPECIMENS	MEAN RATIO	NUMBER OF SPECIMENS	MEAN RATIO
Cape Region	29	.266	7	.265
Central Lower California to Coastal San Diego County	21	.272	23	.276
South-central Arizona	4	.252	11	.259

None of the subcaudal scale-count differences is statistically significant when tested by the small-sample *t*-test; that is, all differences may reasonably be attributed to sampling fluctuations. The closest approach to significance is found in the 30 males in the central Lower California to southern California group. Here the black-red difference is 2.92 and *P* is found to be 0.144.

The differences between the tail proportions have also been tested and are found to be non-significant statistically; they are probably the results of the vagaries of sampling.

While I do not consider these tests entirely adequate, since more adult specimens with complete tails would be desirable, at least there is no particular evidence that the reds and blacks differ in subcaudal scales or tail proportions. Furthermore, it seems to me significant that the territorial variations are paralleled in the reds and blacks—that is, where one is high or low (compared to other territories) the other is likely to be also. Even assuming these territorial variations to be caused by similar ecological pressures, it would hardly be expected that the trends would be so consistent. In this connection it will be of interest to present the statistics of the ventrals, although no red-black differences were found by Ortenburger. Here more adequate territorial segregations are possible since no specimens are eliminated through having incomplete tails.

VENTRAL SCALE COUNTS

		frenatus		*piceus*	
AREA	SEX	NUMBER OF SPECIMENS	MEAN VENTRALS	NUMBER OF SPECIMENS	MEAN VENTRALS
Cape Region	Male	45	202.47	3	202.33
Central Lower California	Male	6	194.50	4	194.50
Northern Lower California	Male	7	194.43	17	194.06
Coastal San Diego County	Male	21	193.71	1	199.00
South-central Arizona	Male	21	195.62	20	196.65
Cape Region	Female	39	199.26	6	199.50
Central Lower California	Female	6	194.00	3	188.67
Northern Lower California	Female	4	192.50	15	192.53
Coastal San Diego County	Female	22	195.50	4	189.50
South-central Arizona	Female	10	194.20	14	194.93

Again we find a consistent parallelism in the territorial variations of the reds and blacks. When it is remembered that the coefficient of variation of the ventrals in homogeneous series is about 2 per cent (or a standard deviation of about 4 scutes) it will be seen that none of the ventral differences between reds and blacks is significant. This table also indicates, by the balance between sexes, that the black color phase is not a sexually dimorphic character.

The new specimens now available have eliminated another difference pointed out by Ortenburger. He found that the specimens of *piceus* from Tucson did not have a light horizontal dash on the loreals, such as characterizes *frenatus* in all areas, and is present in some *piceus* from Lower California. But some of the newer specimens from Tucson, even though quite black, have this dash very clearly in evidence.

OTHER ARGUMENTS RESPECTING THE VALIDITY OF THE BLACK PHASE

Another argument against the specific distinction of *piceus* from *frenatus* is the presence of intergrades in all black-inhabited territories, including those in which the blacks undoubtedly outnumber the reds, namely, the vicinities of Ensenada, Lower California, and Tucson, Arizona.

The range of *piceus* is too spotty to be readily explained, if this form be considered a separate species. Why should it be scattered in a number of

colonies throughout the southwest when adjacent territories of similar character are uninhabited, in all of which the closely related *frenatus* thrives, especially having in mind how much ground this large and active snake could cover? But as a color variant this distribution is not so difficult to understand since various other territorial color differences are apparent in *frenatus*. For example, coastal San Diego County specimens have black necks, while those from the desert side of the mountains and the Imperial Valley are without this dark color or it is only faintly evident. Again, the specimens from San Diego County are predominantly red, while at Cape San Lucas they are usually gray-white or yellow. In other words, other color-defined colonies are not uncommon in this subspecies.

Again it may be mentioned that *C. f. flavigularis*,[4] from which *frenatus* was probably derived (Ortenburger, *l.c.*: 125), also tends to produce black pecially anteriorly) specimens in parts of New Mexico and Oklahoma; while *C. f. flagellum* is characteristically black or dark-brown anteriorly.

It is likewise of interest to note how the snakes of the Lower California islands (both in the Gulf of California and on the Pacific side) have tended to become stabilized at various intermediate color stages between the black and red phases. Only the large Mexican coastal island of Tiburon seems to have both the red and black forms. The islands on which whip snakes have been found are listed as follows:

ISLAND COLOR PHASES

ISLAND	NUMBER OF SPECIMENS	PATTERN CHARACTERISTICS
Carmen	1	A yellowish specimen with punctated head
San José	1	Dark head, yellow to brown body
Magdalena	7	Medium- to dark-brown, much punctated laterally
Ildefonso	1	Dark-brown, lighter toward the tail
Monserrate	5	Dark-brown, lighter toward the tail, much punctated laterally
Coronados (Gulf)	3	Dark-brown to black, with lateral punctations
Espiritu Santo	3	Dark-brown to black, with light longitudinal dashes. One is as dark as any from Tucson
Santa Margarita	2	Black, turning to dark-brown toward the tail
Tiburon	2	One has a peculiar pattern with solid black scales scattered about anteriorly, on a light-brown dorsum. The other is a typical *piceus*

COLOR NOTES

The following color notes were made on a live adult male of the black phase collected by Natt N. Dodge in the Casa Grande ruin, Casa Grande National Monument, Pinal County, Arizona. The capitalized colors have reference to Ridgway's *Color Standards and Nomenclature*, 1912. The snout is Bone Brown; most of the head, especially the top, is Fuscous-Black; however, there is a pair of Cameo Brown blotches on the parietals. On the under-

[4] I cannot see by what line of reasoning the name *testaceus* of Say is not applicable to this subspecies. At the time the type specimen was collected (about July 18, 1820) the Long Expedition was at the foot of the Rocky Mountains, toward the headwaters of the Arkansas River. The description, though brief, fits no other snake found in that region. It does fit the prairie racer, usually referred to as *C. f. flavigularis*, and this snake does occur in that vicinity. I am therefore of the opinion that this prairie subspecies should be known as *Coluber flagellum testaceus* Say, 1823.

side of the head there are Hair Brown spots on a White background. Dorsally the neck is Black, becoming Blackish Brown after passing mid-body, and turning to Dusky Drab at the tail. The scales are light-edged; this becomes increasingly apparent posterior to mid-body, the light color being Vinaceous-Russet. Ventrally the color on the neck is Hair Brown; it is fairly solid at the neck, but is displaced posteriorly more and more with light colors. At mid-body the light ventral color is Congo Pink; this becomes LaFrance Pink under the tail.

While on the subject of color I should state that preserved specimens do not give an accurate idea of colors in life. Red tends to become brown, while pink turns to yellow or buff. Thus the beautiful red snakes which are characteristic of parts of San Diego County are usually brownish when preserved; and the pink posterior and ventral colors of Arizona *piceus* fade badly to neutral buff or cream. Preserved specimens are much more uniform in color than when alive.

Many juveniles from areas where both color phases occur are dark-brown, and even in areas where there are only reds, the young are darker than the adults and are usually blotched. However, the young of *frenatus* and *piceus* are sometimes distinguishable, for lately I have received from Lee W. Arnold a young black specimen only 467 mm. in length. This is from 10 miles south of Tucson. But young black specimens are quite rare; it must be that in some areas young *piceus* are dark-brown. I hope that some day the hatching of broods may solve this color-phase problem as completely as it has that of the king snakes of San Diego County.

Ontogenetic variation is not great in these whip snakes, but it is present, the adults having slightly longer tails, proportionately, than juveniles. For example, in a group of *frenatus* from San Diego County the adults (over 1000 mm. long) had an average ratio of tail length to total length over-all of .266, while the juveniles under 500 mm. averaged .248. The difference proved to be significant.

Ranges

Since Ortenburger did not publish complete locality lists of the specimens he examined and new material has lately become available which extends the known range of the black whip snake, especially north and west from Tucson, I present herewith a list of the localities known to me. However, the red racer localities are so voluminous that I shall not list them at this time. If one makes a practice of checking DOR specimens, locality records of this species become very numerous, for this snake is not only common but is a considerable traveler, so that many are run over. However, I shall present data on the limiting localities of the red racer, as now known, to outline the range.

The black phase has been collected or observed at the following places:

Lower California.—*Southern Area*—Todos Santos, San Bartolo, Triunfo, San Pedro, La Paz, Vinoramus Ranch (10 mi. s. of La Paz), and 23 mi. w. of La Paz[5]: *Central Area*—Loreto, San Ignacio, San Bartolomé Bay, and San Borjas: *Northern Area*—San

[5] Apparently the black phase does not occur at the southern tip of Lower California, for it has not been taken at the frequently-collected localities of Cape San Lucas and José del Cabo. One lot of about 100 live red racers—in reality white, light-yellow, or light-gray—from Cape San Lucas did not contain a single black specimen.

Quintín, north arm San Quintín Bay, Agua Chiquita (4 mi. n.e. of San Quintín), and San Ramón (mouth of Santo Domingo River), Santo Domingo, San José (Lat. 31°), Las Cabras (w. of San José), San Antonio del Mar (Johnson's Ranch), Rosarito (San Pedro Mártir Mts.), Joruncho Ranch (s. of El Valle de La Trinidad), San Pedro Mts., 1½ mi. s. of Santo Tomás, Sangre de Cristo, Ojos Negros, Ensenada (also 5 and 7 mi. s.), Sauzal, El Descanso (also 10 mi. s.), Rosarito Beach (also 1 mi. s., 5 mi. s., and 2 mi. n.), 5½ mi. s. of Shore Acres, 8 mi. s. of Carrizo Ranch (e. of Matanuco), and Garcia (S. D. & A. E. Rwy.).

CALIFORNIA.—*San Diego County*—Otay, Otay Mesa (intermediate coloration), Dulzura, summit of road between Dulzura and Marron Valley, Bingville, Campo (intermediate coloration).

ARIZONA.—*Maricopa County*—25 mi. e. of Gila Bend: *Pinal County*—7 mi. s.e. of Apache Junction, Florence Junction, Florence (also 15 mi. e.), Casa Grande National Monument: *Pima County*—2 mi. e. of Dowling's Well (Organ Pipe Cactus National Monument), 9 mi. n.w. of Quijotoa, Catalina Mts., Cañada del Oro (18 mi. n. of Tucson), Fort Lowell, Tucson (also 19 and 13 mi. n., 10 mi. e., 10 mi. s., and 4 mi. w.), 2 mi. w. of Sabino Canyon, 3½ mi. w. of Tanque Verde, south base Rincon Mts., Martinez Hill (10 mi. s.w. of Tucson), Xavier, and Felix: *Graham County*—Camp Grant (type locality of *piceus*).

SONORA.—10 mi. n. of Magdalena, 30 mi. s. of Noria, 15 mi. s. of Hermosillo, and near La Posa.

The range of the red racer is described as follows: It occurs all through Lower California from Cape San Lucas to the U. S. Boundary, and from coast to coast. In the northwestern section from San Quintín to Rosarito Beach the red phase is outnumbered by the black.

In California the red racer is very common in the southern part of the state from the coast to, and including, the desert. West of the Coast Range I have collected it as far north as San Lucas, Monterey County, and Miss Margaret Story reports one from 20 mi. s. of Hollister, San Benito County. There is a specimen in the Stanford collection from Palo Alto, Santa Clara County, which Van Denburgh considered doubtful; and another in the U. S. National Museum from San Francisco which is certainly an inaccurate record.[6] In the Sacramento and San Joaquin valleys the most northerly record is 8 mi. w. of Arbuckle, Colusa County. Other northerly localities are 11 mi. w. of Los Baños, Merced County; 3 mi. w. of Conejo, Fresno County; and near Modesto, Stanislaus County. East of the Sierra Nevada it ranges at least to the northern edge of Inyo County, where it has been collected at such points as Bishop (also 5 and 9 mi. w.) and Keough Hot Springs.

The known range in Nevada may be roughly indicated by a line drawn from Winnemucca Lake in Washoe County to extreme northeastern Clark County (where it has been collected at Bunkerville and Mesquite), the red racer inhabiting the territory south and west of this line. Records from the northern part of this range are not plentiful. I observed DOR specimens at Fernley, Lyon County, and Derby, Washoe County.

In Utah the red racer seems confined to the extreme southwestern corner of the state, where it has been observed at such points as St. George, Zion National Park, 6 mi. w. of Rockville, and Harrisburg, all of which are in

[6] This specimen reached the museum from the same source as the type specimen of *Crotalus ruber*, which was likewise allocated to San Francisco, although this species does not occur north of southern Los Angeles County. One can often check the probable accuracy of old records by noting other specimens in the same lot.

Washington County. There is a Salt Lake City record which is to be considered doubtful.

In Arizona it occurs south and west of a line drawn from the northwest corner (where it has been collected at Littlefield, Mohave County) to the southeast corner (where it has been collected at Douglas and Chiricahua R.R. Station, Cochise County). While occurring all through the plains and desert it is probably absent from the higher mountains in this area. Its presence in the Winslow section is possible but not yet verified. Whether any specimens from southwestern New Mexico should be allocated to *C. f. frenatus* (= *piceus*), or whether all should be considered *C. f. testaceus,* is not certain. In fact, it may be that the snakes of extreme southeastern Arizona should be considered *testaceus* rather than *piceus;* some from this area have the peculiar broad bands found occasionally in specimens of *testaceus.*

In Sonora the red racer occurs to the southern limit of the state; I have a specimen from Agiabampo at the southwestern corner. Ortenburger mentions a specimen from Atlata, northern Sinaloa.

Acknowledgments

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Summary

Coluber flagellum frenatus and *Coluber piceus,* the red and black whip snakes of the southwest, usually considered separate species, are found to be color phases of a single subspecies which should be known as *Coluber flagellum piceus,* for differences hitherto used in separating them are not evident in new material now available.

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SAN DIEGO, CALIFORNIA.

A Fish with Feather-like Gill-Leaflets

By P. J. SCHMIDT

P. S. PALLAS in his famous *Zoographia Rosso-Asiatica* (1811: 173 a. 179) mentioned the presence near the coasts of Kamchatka of *Blennius galerita* Linnaeus and of a new "anomalous" ("species anomala") *Blennius polyactocephalus*. Probably the first mentioned species was a young specimen of the second, since Pallas says, that "hanc specimen e fide Stelleri recenseo, qui se scribit eam juniorem in littore Camtschatico semel observasse." The real *Chirolophis galerita* (Linnaeus) is known only from the Atlantic coast of Europe.

Jordan and Starks (1895: 841) described this peculiar fish as having the head crowned with Erect cirrhi, according to a series of well preserved specimens from Alaska, Kamchatka and Pribilov Islands. They created for it a new genus, *Bryostemma,* which presumably differs from the Atlantic *Chirolophis* Swainson in the absence of a true lateral line. The American authors were informed by Dr. G. A. Boulenger (British Museum), that a true median lateral line is developed in *Chirolophis ascanii* (Jordan and Evermann, 1898: 2408). But later H. Rendahl (1931: 54; cf. also Smitt, 1893: 219), comparing a specimen from Kamchatka with *Chirolophis ascanii* from the Swedish coasts of the Atlantic, has found no difference in the general structure of the lateral line. Both species have no real lateral line and show only a beginning of it in a row of 6–15 pores over the pectoral fin. I have also compared the Pacific and the Atlantic species and can confirm that the difference between both is only in the number of pores. It is therefore needless to divide this group into two genera; and the Pacific species can be referred to *Chirolophis polyactocephalus* (Pallas), inasmuch as both have the same very peculiar structure of gills, which strangely had been until now overlooked by the many ichthyologists who had studied these interesting and not too rare fishes.

The four gill-arches of *Chirolophis polyactocephalus* are placed in a very narrow gill-chamber, closed from behind by the opercle which is provided with a broad and thick cutaneous border that is densely pressed to the posterior part of the chamber and to the base of the pectoral fin. A special osseous rim, forming a posterior border of the gill-chamber, makes the joining more hermetic. From below, the gill-chamber is closed by the united gill-membranes, which form a broad fold, pressed to the isthmus. The upper part of the opercle above the pectoral fin is elongated in a cutaneous flap, connected with a special skin-fold on the body surface and forming, together with the latter, a real siphon for the ejection of water from the gill-cavity. In the mouth cavity, two broad membranes on the upper and lower jaws form valves retaining the flow of water in the contrary direction.

Each gill-arch has along its anterior border a broad membranous strip (Fig. 1, 2, M), probably closing as a valve the gill-slit between two arches. The gill-rakers are conical or flat, some of them with small spines; there are 5 + 10 in the outer row of the first arch, these short and not projecting over the border of the gill-arch. Along the posterior border of the gill-arch are placed the gill-leaflets (Fig. 1, GL) in two very dense rows. Those of the left

row alternate with those of the right (Fig. 2, C). The structure of each gill-leaflet is more complex than is usual in fishes. Each leaflet is feather-like and carries on both sides a series of about 100 small leaflets of the second order (Fig. 2, D.E), which are densely pressed together like tiles, causing the whole gill-leaflet to be somewhat swollen. Both borders of the gill-leaflet are thickened (Fig. 1) and evidently conceal the chief blood vessels supplying them

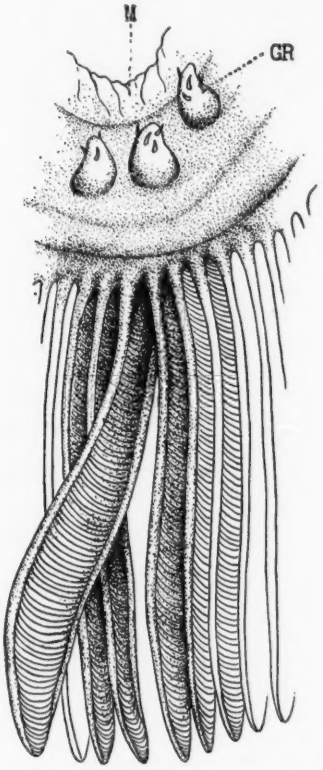

Fig. 1. A part of the first gill-arch of *Chirolophis polyactocephalus* (Pallas) with gill-leaflets (GL) and gill-rackers (GR). Only the outer row of the leaflets is figured, the inner row is omitted for simplification. Enlarged.

with blood. Such a structure makes the surface of each gill-leaflet two to three times larger than is usual in fishes, and may be connected with the comparatively very small size of the whole gill-apparatus of *Chirolophis polyactocephalus* and the large size of the body, which requires much oxygen.

The gills of *Chirolophis galerita* (Linnaeus) (=*ascanii* Walbaum), studied on one specimen of our collection from the Barents Sea, are of the same general structure, as those of *Chirolophis polyactocephalus*, but this species seems to be a dwarfed Atlantic representative of the Pacific group. It is com-

paratively small, and its fins and the cirrhi on the head are less developed. In connection with its dwarfness the gill-leaflets of the first and of the second order are smaller and not so numerous as in the Pacific species.

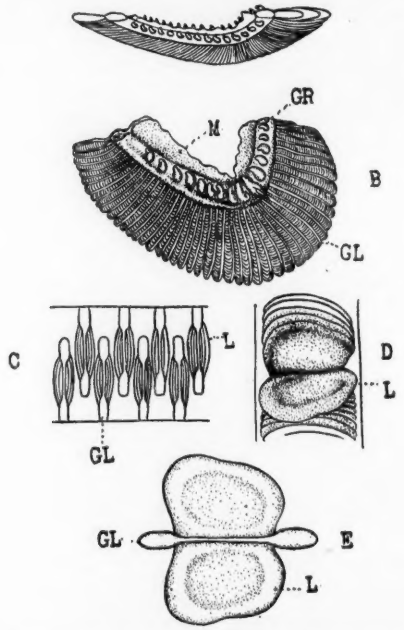

Fig. 2. A, first gill-arch from the front; B, the same from the outer side; C, a part of the first gill-arch from behind (schematically to show the disposition of the gill leaflets); D, a part of a gill-leaflet of the first order with small leaflets of the second order; E, gill-leaflets of the second order from above (schematically). GL, gill-leaflets of the first order; GR, gill-rackers; L, gill-leaflets of the second order; M, membrane of the anterior border of the first arch.

It seems to me that such a structure of the gills is a very special adaptation designed for the reinforcement of the breathing, and is unique among the fishes.

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Habitat and Breeding Behavior of the American Cyprinid Fish *Notropis longirostris*

By Carl L. Hubbs and Boyd W. Walker

ALMOST nothing has been recorded concerning the natural history of the eastern longnose shiner, *Notropis longirostris* (Hay), a cyprinid fish of the eastern Gulf States. The few observations that we have made on this species indicate that its habitat and its reproductive ways are distinctive and interesting. A thorough investigation of its ecology and habits would seem called for. Since it is improbable that we shall soon be able to return to the study, however, the limited data now at hand are herein reported.

Habitat

Notropis longirostris is a common inhabitant of the clear, sandy streams along the coastal plain of the Gulf of Mexico, from eastern Louisiana through the southern parts of Mississippi and Alabama to western Florida and southwestern Georgia. In various parts of this range, particularly in southern Mississippi near Biloxi, field observations have demonstrated that the normal habitat of the species is the shifting, white sand bottom, in moderately rapid water, at depths varying from a few centimeters to half a meter.

Except for obvious strays from adjacent habitats, such as pools and gravelly riffles, few fishes, indeed few organisms of any kind, inhabit stream bottoms of moving sand. The most characteristic associate of the eastern longnose shiner is a translucent, sand-burrowing darter, *Ammocrypta beanii*. The advantages gained by lack of competition may compensate for the barrenness of the habitat. Several studies, for example that of Tarzwell (1937: 181–187), have indicated that the shifting sand of streams is a biological desert, with a minimum of food production. No doubt some food drifts down over the sandy shoals, from pools and riffles above. For this reason, possibly, *Notropis longirostris* occurs most commonly on the short sand shoals between pools, or in the current along the feather edge of pools, and is rare on long, unbroken stretches of sand where other conditions seem suitable.

A very similar species, *Notropis sabinae* Jordan and Gilbert, appears to select a similar habitat in the waters west of the Mississippi River, from southeastern Missouri and northeastern Arkansas to eastern Texas. Two others, *Notropis bairdi* and *Notropis girardi* Hubbs and Ortenburger (1929: 29–33), occupy similar niches in the Red and Arkansas rivers, respectively. Farther north *Notropis dorsalis* is the ecological analog.

All of these psammophilous shiners have characteristics that are related to their peculiar habitat. They are very pale, with small, inconspicuous melanophores, and their flesh has a semipellucid quality. As a consequence they blend extraordinarily well with the white sand which they frequent. In correlation with their life on the open bottom in the current, they have terete bodies, with the dorsal contour more strongly arched than the ventral. The pectoral fins are large and horizontally expanded. The snout is long and decurved, and the large mouth is inferior. These morphological features adapt the fish to swimming about and feeding over the open bottom, in the current.

The form of the head, body and fins is such as to increase the downward component of the force of the current, so as to help hold the fish against the bottom. Such adaptations to current conditions are common in stream fishes (Hubbs, 1941: 185–187, 192).

A particularly striking parallel to *Notropis longirostris* in form and color is provided by another minnow of the shifting sands, *Ericymba buccata*. This similarity was noted by Hay (1881: 504) in his original description of *Alburnops longirostris*. Hubbs (1941: 186) and Hubbs and Lagler (1941: 59–60) have commented on the similarity in the habitat preference of *Ericymba buccata* and *Notropis dorsalis*, and on the almost completely complementary though widely overlapping distribution of these two cyprinids. It is therefore of interest that *Notropis longirostris* and *Ericymba buccata* have commonly been taken in the same collection, by Hay (1881: 504–507), as well as by us. We have noted, however, that where they occur in the same locality, as in southern Mississippi and Alabama, *Notropis longirostris* seeks the shallows, and *Ericymba buccata* the deep current. The depth contour of about 0.5 meter very largely separates the populations. Thus *Ericymba buccata* avoids competition with *Notropis dorsalis* by geographical, and with *Notropis longirostris* by ecological, segregation.

Breeding Behavior

While preparing to make a fish collection in Escambia River at Flomaton, near the Florida border of Alabama, on the bright mid-afternoon of April 11, 1941, we observed *Notropis longirostris* in high breeding activity. The conditions for observation were so perfect that many phases of the nuptial behavior were repeatedly seen, though only an hour or so could be spared for this study. Most of the actions could be followed by the naked eye, but the details of behavior were more satisfactorily observed with the aid of 8× binoculars. The water was clear, and many of the fish were spawning about 2 to 3 meters off the shore of the gravel and sand bar, at a depth of 15 to 30 cm. When approached the fish often moved out a short distance, but when quiet was maintained they soon slid back to re-engage in their breeding. Almost no other fish were present in this habitat, although *Ericymba buccata* and other species were common in slightly deeper water near by. The spawning site was on the feather edge of a current pool just above a broad, long shoal. The current was moderately rapid, so that the fish were forced to exert themselves in maintaining their position on the bottom. The clean sand which here floored the stream was deeply riffled. Small pockets of very fine gravel had collected in many of the troughs between the sharp sand ridges.

The sexes were distinguished in the water largely by the brighter color of the males. Freshly caught males were a little more deeply amber-colored, less ghostly pale than the females. Their fins were more definitely washed with transparent lemon yellow. There was also some yellow about the mouth and the nostrils were pinkish. In most of the mating pairs the male was definitely the larger, but measurements on the ripe fish collected in the Escambia River indicate very little if any sexual dimorphism in size: 12 males range in standard length from 42 to 50 mm., with an average of 46.0 mm., whereas 20 females varied from 38 to 52 mm. in length and averaged 45.2 mm. The

sexual differences in the form of the body and in the length of the fins are very weakly marked in this species.

The nuptial tubercles are too small in this fish to serve as a means for distinguishing males from females in the water. As these organs are commonly of significance in the breeding behavior, however, their characteristics in *Notropis longirostris* are described. The fine, rather numerous, conical tubercles of the male are distributed over the head in a rough pattern. There is an uneven row along each upper orbital margin. Medially the conelets tend to be grouped into two rows, which begin near the front of the nostrils and extend to opposite the hind margin of the orbit. Between these rows (in the middle of the interorbital region) and between each of the rows and the supraorbital row, there is an area largely devoid of tubercles. The snout is thickly studded but the mandible has only a few weak scattered pearl organs. There are a few of these structures just behind the eye and on the top of the head posteriorly. About half of the males—the more highly developed ones—have tubercles sparingly placed over the exposed portions of the scales on the anterior two-thirds of the nape. On the pectoral fins the relatively minute, conical organs have conjoined bases, and are arranged distally in about 4 rows, on each of the rays except the first and the last 3 to 5; the outer part of all the rays are unarmed. In some of the large females the nuptial tubercles are slightly developed.

The males and females were fully ripe on April 11, 1941, for the sex products were exerted on slight pressure. The females collected contained few ova, indicating that the spawning season was drawing to a close. Hay (1881: 504) described females collected in April, 1880, as "teeming with eggs" (this is the only published remark on the reproduction of *Notropis longirostris*).

During courtship a male persistently followed a female, who seemed to attempt to escape, but generally not wildly. As the pair moved slowly upstream, close to the bottom, the male continuously nudged the female's vent region from below, apparently bringing the nuptial tubercles of the snout into play. At times he gained a tail purchase on the bottom, and then shoved the female particularly hard. Occasionally the male, increasing the tenseness of his movements, slid his head forward into contact with the lower surface of the female's head. Following this behavior he usually attempted to clasp, bending his head region upward and again pushing against the bottom with his tail. At this time he appeared to attempt a pectoral fin lock (a frequent phenomenon in spawning cyprinids, correlated with the development of strong nuptial tubercles on the upper surface of the pectoral rays). Emission of eggs and sperm was not observed, though it may have taken place at this stage of the nuptial behavior. No definite redd seemed to have been constructed or dug.

Much time was spent by each male in driving off others of his sex that attempted to follow his temporary mate. A constantly shifting territory a few inches in diameter around the female was protected. When a second pursuing male entered this limited area the original holder attempted to drive him off, usually with success. Often, however, a fight ensued, in which the combatants moved in a small circle, biting at the midsides or pectoral fins of one another (without causing any apparent injury). The defender ordinarily emerged the

victor. Sometimes several males engaged in "battle royal." During the combats, whether of two or more males, the females seldom moved far off, but seemed to await the outcome. Occasionally, while the fight was in progress, the female became attended by a new suitor, and in some if not all of the observations was seen to move off with him. When a fighting male was deserted by his mate, he acted as though he were much disturbed when he failed to find her, after returning from the combat to the place where he had left her. His reaction under these circumstances was to zigzag wildly upstream. The males as well as the females were seen to be promiscuous in their mating; they often changed mates.

At times a male nudged another male, whereupon a "ceremonial march," extending for a few inches, commonly ensued.

The reproductive behavior of *Notropis longirostris* parallels in several ways the observations which have been recorded for other ostariophysine fishes, for instance in the papers by Reighard (1910, 1920), Traver (1929), and Raney (1940 *a-b*). Of especial interest is Hankinson's brief description (1919: 141–142) of the breeding behavior of *Ericymba buccata*. It seems that *Notropis longirostris* and *Ericymba buccata* closely resemble one another in their reproductive habits as well as in their habitat selection.

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A New *Scorpaena* from the Texas Coast, with Notes on *Scorpaena mystes* Jordan and Starks

By Gordon Gunter

Scorpaena ***ginsburgi,*** sp. nov.

A SPECIES closely related to *Scorpaena plumieri* Bloch, from which it differs chiefly in having a much shallower and somewhat broader interorbital space and a less prominent suborbital pit, with pits and ridges not so prominent, the spines more delicate and the tabs and skin flaps less common, thinner and finer. It also differs in color.

I consider it appropriate to name this little scorpionfish for Mr. Isaac Ginsburg, in appreciation of his keen researches in the taxonomy of fishes.

Diagnosis.—Dorsal XII, 10; and III, 5, second spine longest, last ray split to base; top ray of pectoral unbranched, next 5 to 8 branched and the lower 11 to 12 unbranched; pelvics I, 5. In standard length: depth 2.29-2.96, width 3.46-4.59, head 2.31-2.67. In head: snout 3.57-4.37, maxillary 1.89-2.19, eye 4.17-5.13, interorbital 4.17-5.00. Villiform teeth present on mandibles and premaxillaries and in narrower bands on the vomer and palatines, also on upper and lower pharyngeals. Scales cycloid, all with skin flaps, those of the breast embedded, numbering 30 to 35 vertically and 40 to 47 along the lateral line; pores 20 to 23; gill rakers 9.5 to 11.4 on outside gill bar; branchiostegal rays 7. Nasal, preocular, supraocular, postocular, sphenotic, pterotic, posttemporal, coronal, occipital, postoccipital, nuchal, humeral, opercular, preopercular, preorbital and postorbital spines present. This diagnosis is based on measurements of twenty specimens all from the Gulf and bays adjacent to Aransas Pass of Aransas Bay.

Specimen 1, No. 119016, here designated as the holotype, was taken 10 miles southeast of Aransas Pass jetties, by a shrimp trawl in 10 fathoms of water, December 5, 1940. The owner, Mr. Antonio Garcia, kindly presented it to me. It is in the U.S. National Museum. The fish is the largest and best specimen seen and is typical in every way except that at a point on the posterior trunk region the lateral line disappears for a short distance. At this place the scales are slightly smaller than usual, and since the pores disappear, too, the pore count is lower. That is an individual abnormality.

Specimen 2 (USNM No. 119018), designated as paratype 1, was found by the writer on the Gulf Beach of Mustang Island, Texas, on January 24, 1940, where apparently it had been killed by the cold and rolled ashore (Gunter, 1941a). Specimens 3 (paratype 2, USNM No. 119017) and 4 (paratype 3, USNM No. 119015) were kindly given me by Mr. Clyde T. Reed. They were taken at the same locality during the summer of 1938. Specimen 5 (No. 15202, American Museum of Natural History), was taken at a snapper bank off Freeport, Texas, and was loaned to me through the kindness of Mr. J. T. Nichols.

The various characters of each specimen are given in the following table:

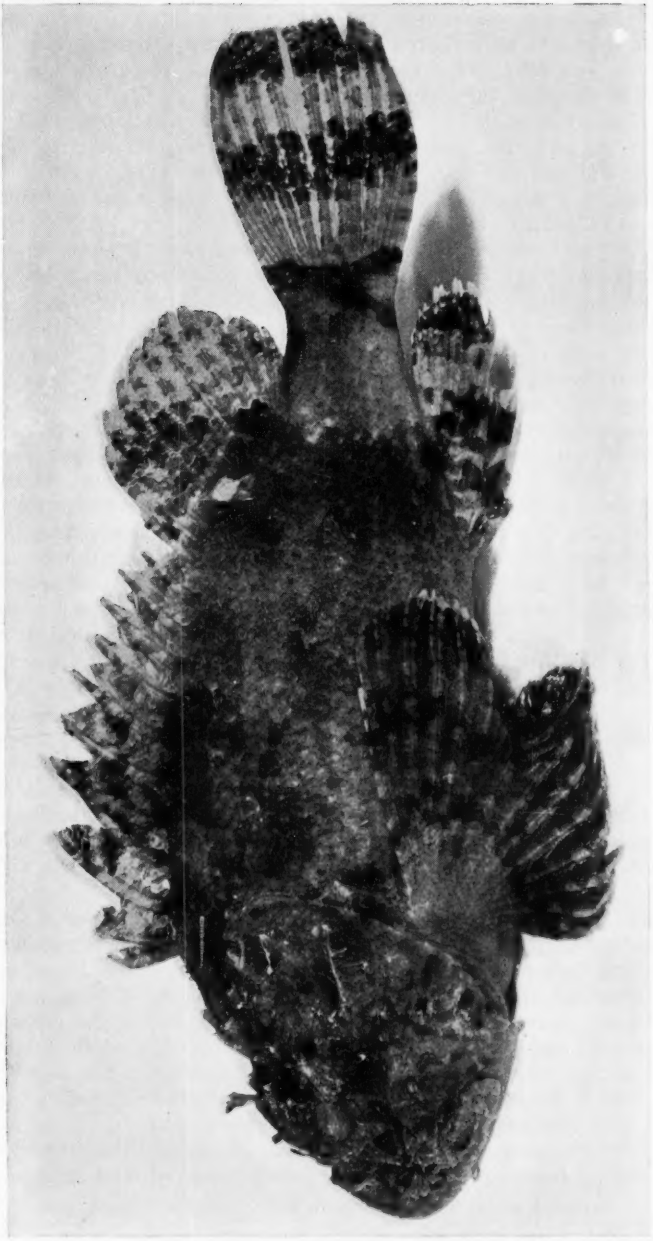
TABLE 1
MEASUREMENTS OF SPECIMENS, IN MILLIMETERS

Specimen	1	2	3	4	5
Total length	256	166	192	167	175
Standard length	198	131	147	130	135
Depth	73	51	57	52	59
Width	56	30	32	33	35
Head	81	53	55	50	57
Snout	20	13	14	14	14
Maxillary	40	28	29	25	26
Eye	15.5	12	12	11.5	11
Interorbital Width, depth	18.5	12, 3.0	13, 3	12, 3.0	13.5, 3
Occiput pit Length, width	10, 14	9, 10	10, 11.5	8.5, 10	8.5, 10.5
Dorsal base	126	84	96	86	88
Highest spine (4th)	32	23	24	22	24
Highest ray	34	5th, 20	5th, 26	4th, 24	5th, 24
Caudal Count	11 & 7 stubs	11 & 7 stubs	11 & 8 stubs	11 & 9 stubs	11 & 8 stubs
Length	50	33	33	36	23
Anal base	30	21	25	22	
length	60	37	44	39	40
Longest spine (2nd)	34	23	27	26	24
Pelvic base	9.5	8	9	8	7
Longest ray (2nd)	52	34	39	36	38
Pectoral count	1, 7, 11	1, 5, 13	1, 5, 13	1, 7, 11	1, 6, 12
Longest ray	4th, 73	5th, 41	6th, 51	6th, 47	6th, 44
base	33	22	24	22	23
Scales—vertical					
horizontal	34, 49	34, 44	34, 47	35, 44	34, 47
Pores	18	about 20	21	21	21
Caudal peduncle length, depth	15, 23	12, 16	15, 17	12.5, 15.5	11, 16
Tabs	smooth	smooth	tabbed	tabbed	smooth

* The maxillary extends beyond the eye in all specimens. The counts of the pectoral are in the order of unbranched, branched, unbranched from above downwards. The head is wider than the body. The above width measurement is taken at the widest part of the body.

In addition to the holotype and paratypes, Mr. Clyde T. Reed of Gregory, Texas, loaned me several more specimens. Of these, 15 were considered to be adult and were used for comparative measurements. The fish were compared with 18 specimens of *Scorpaena plumieri* from Florida, Bermuda, Jamaica, Puerto Rico, Panama, Venezuela and Brazil, and I am indebted to officials of the Field Museum of Natural History, the American Museum of Natural History and the U. S. National Museum for the loan of the specimens. Proportional measurements were made and compared. There seems to be no significant difference in proportions of the depth, head, eye, snout, maxillary and various fins. The gill raker count was not at variance with that of *S. plumieri.* The writer pointed out before (Gunter, 1941b) that the gill raker count given in the literature for that species varies from 7-4 to 11-4.

The color pattern of this fish is much like that of *S. plumieri,* but the color itself in formalin is quite different. There are two mottled bars on the tail and another on the caudal peduncle barely on the edge of the tail. A diffuse dark area starts on the forward part of the soft dorsal and extends downward, becoming lighter, to the anal. A second broad area is on the shoulder region and runs diagonally to and above the upper part of the operculum, extending between the head and the first spine of the dorsal. The head and fins are mottled. The belly region is pale. The axil is black, with irregularly round



Scorpaena ginsburgi, paratype 2.

white spots. The base color is a purplish grey. According to Mr. Reed, the color of specimens he has taken in life is very much the same. The type specimen when alive had a reddish orange color on the breast and was mottled on the pelvic and pectoral fins.

Of 23 examples of this species, only 3 possessed skin tabs over the eyes, and the contrast with *S. plumieri* in this respect is very noticeable, for most individuals of that species are heavily tabbed and tentacled to the extent that they may be called shaggy. Only 3 out of the 14 specimens of *plumieri* measured did not have supraocular tentacles.

Although the new species resembles *Scorpaena mystes* [1] in some respects, it is more closely related to *plumieri*. The most striking difference between the latter two species is the shape of the head. The head of *mystes* is flatter, and when viewed from the side, the upper and lower profiles are straight lines, the projections of which would cross not far in front of the mouth. In contrast, the head profile in *S. plumieri* and *S. ginsburgi* is slightly curved above and the gular region is swollen out so that the lower head margin is a strong convex curve. Some of the *mystes* were light in color and were not notably darker than *plumieri* except for a specimen from Chatham Island (Mus. Comp. Zoöl. No. 29, 718). This specimen had heavy scale flaps and some tabs on the chin. No specimen had supraocular tentacles, and except for the one mentioned, they were devoid of tabs. The spines are more delicate than in *S. plumieri*. Spines in the scorpion fishes are very constant features and any variation is more important than the size of the object would indicate. In contrast to *S. plumieri* and *S. ginsburgi, S. mystes* sometimes has a secondary nasal spine on the primary spine, and the first spine of the suborbital stay is usually bifid. The anterior termination of the suborbital stay, a series of radiating ridges, is much more deeply trenched and sharply ridged than in the other two species. In further contrast the posterior portion of the stay is secondarily ridged in most specimens. More striking is the fact that the distance between the eye and the suborbital stay is much less in *mystes* than in the other two species, equaling half or less of the vertical measurement of the eye, while in the other two fishes the distance is three-fourths of the vertical diameter of the eye. Furthermore, the occipital pit is a little shallower and a little longer than wide, in contrast to the other two species, where it is wider than long.

Table 2 shows that *S. mystes* is not so deep as the other two species. Only 6 examples of this species were measured, for the other 3 available specimens were judged to be too small. The interorbital in head is least for *S. ginsburgi* and greatest in *S. mystes*. Jordan and Evermann (1898) stated that *S. mystes* had a wider interorbital than *S. plumieri*. Measurements of the available specimens did not bear out this statement. The depth into width of interorbital is much greater in *ginsburgi* and about the same in the other two fishes. This is due in part to the greater interorbital width of *ginsburgi*, but mostly to its shallowness.

In brief, *Scorpaena ginsburgi* differs from *S. plumieri* in the greater width and shallower depth of the interorbital, giving the top view of the head a

[1] Nine examples of *Scorpaena mystes* were examined and I am indebted to officials of the U. S. National Museum, the Field Museum of Natural History, the Natural History Museum of Stanford University and the Museum of Comparative Zoölogy for the loan of the specimens.

TABLE 2

MEASUREMENTS OF THREE SPECIES, IN MILLIMETERS

Scorpaena plumieri					*Scorpaena ginsburgi*					*Scorpaena mystes*				
Standard Length	Depth	Head	Interorbital Depth	Interorbital Width	Standard Length	Depth	Head	Interorbital Depth	Interorbital Width	Standard Length	Depth	Head	Interorbital Depth	Interorbital Width
168	65	68	5	15.5	131	51	53	3	12	119	40	48	3	9
151	55	68	6	12	147	57	55	3	13	116	37	46	3.5	9.5
200	69	90	6	18.5	130	52	50	3	12	144	47	58	4.5	10.5
157	55	63	4	12	135	59	57	3	13.5	133	43	55	4	11
176	69	66	5.5	14	166	56	70	4	15	126	39	52	3.5	10
153	52	58	4.5	11	144	52	60	4	12	243	83	100	6.5	17
156	57	65	4.5	14	127	50	50	3.5	12					
161	59	62	5	12.5	131	50	51	4	10					
242	87	105	8	17	141	51	54	3.5	13					
176	69	66	6	15	138	51	54	3.5	12					
95	36	38	3	8.5	137	50	57	4	12					
119	47	50	4	11	145	55	58	3.5	13					
120	52	52	3.5	10.5	147	50	58	4	13					
112	43	45	4.5	10	139	47	59	4	13					
					149	57	56	4	14					
					138	52	56	4	13					
					142	53	57	3.5	12.5					
					128	49	54	4	11.5					
					198	73	81	5	18					
					164	60	62	4.5	14					

different appearance, which is a measurable factor; and it differs in three ways not subject to measurement, namely, color, sparseness of skin flaps and tentacles and in being less rough and having more delicate spines.[2] It resembles *S. mystes* in the last two characters and in the smaller suborbital pit, and differs in the characteristics pointed out above. Table 3 is a summary of the differences among the three species. I believe these differences are enough to give the fish specific rank. If future work shows that there is overlapping of range and interbreeding with *plumieri,* to which there is no known barrier, then it will be relegated to subspecific rank.

In the description of *Scorpaena nuttingi,* Evermann and Seale (1925) made two conflicting statements about the branching of the pectoral rays. I am indebted to Mr. Charles E. Wilson, of Iowa City, Iowa, for examining the type and sole example of this species in the State University of Iowa Museum. He has informed me that it differs from *Scorpaena plumieri* in having the top pectoral ray, as well as the eight ventral to it, branched. The top ray is always simple in *S. plumieri. S. nuttingi* differs from the species here described by the same characteristic.

TABLE 3

IDENTIFYING CHARACTERS OF THE THREE SPECIES

Characters	*ginsburgi*	*plumieri*	*mystes*
Interorbital space	wide, shallow	narrower, less shallow	narrow, deepest
Profile of head	gular region curved	gular region curved	gular profile straight
Suborbital pit	less prominent	very prominent	less prominent
Pits and spines; general rugosity	less heavy	very heavy	less heavy
Depth	similar to *plumieri*	similar to *ginsburgi*	shallower than other two
Color	purplish gray	sandy to tarry brown	sandy to tarry brown
Tabs and tentacles	not heavy, usually absent	heavy, rarely absent	not heavy, usually absent
Nasal spine	single	single	often with secondary spine
First suborbital spine	single	single	usually bifid
Distance from eye to suborbital stay	about three-fourths diameter of eye	three-fourths diameter of eye	less than half diameter of eye
Occipital pit	wider than long	wider than long	longer than wide

[2] Dr. Leonard P. Schultz, who has examined the types and paratypes after they were deposited in the U.S. National Museum, noticed that possibly there was some difference in the relative lengths of the soft rays of the dorsal and anal in comparison with the spines of the two species and suggested closer examination of that point. Unfortunately my specimens of *S. plumieri,* all borrowed from various museums, were returned before his communication was received and so the comparison could not be made.

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GAME, FISH AND OYSTER COMMISSION, ROCKPORT, TEXAS

Contributions from the Zoological Museum of Stanford University, California, IX. Two New Species of *Petroscirtes* and a Key to the Philippine Species

By ALBERT W. C. T. HERRE

THE genus *Petroscirtes* includes 25 or more species of small carnivorous blennies in tropical Indo-Pacific waters. The name *Petroscirtes*, meaning rock springer, was applied by Rüppell more than a century ago, after watching the antics of a species on the reefs and rocks of the Red Sea. Skipping about and chasing tiny crustacea over the rocks as agilely as lizards, the little blennies would transfix their prey with the enormous curved canines that seem so preposterously large in their mouths. The name *Petroscirtes* always seemed exceedingly appropriate to me, but my 1940 collecting trip showed that at least some of the species live in mangrove swamps, where mud is dominant.

The 17 species listed here are certainly not all that occur in Philippine waters. No doubt all the species recorded from the East Indies will be discovered in the Philippines ultimately. The species of *Petroscirtes* are not easy to collect, as they are shy, elusive, and swift. The rock-springers are not only able to hide inside coral heads and to seek refuge in tiny rock crevices, but we know now that some kinds live in the muddy channels of mangrove swamps, where it is difficult to get them. As a result of collecting in mangrove swamps during the summer of 1940, I present two new species of *Petroscirtes* from the Philippines. Most of them are marine, but several species enter fresh water streams, and one Philippine species is only known from a fresh-water lake.

Petroscirtes Rüppell

Petroscirtes Rüppell, Atlas, Fische Rothen Meers, 1837: 110.

The body is naked, more or less elongate, with a small or moderate-sized head; tentacles are present on the eyes, nape, and nostrils in some species; a few kinds may also have them on the opercular and preopercular margins, under the chin, and on the throat. The snout may be convex, steep, and short, or elongate and conical. The teeth are small, fixed, in one row, with a pair of very large curved posterior canines in the lower jaw, and a pair of similar but much smaller canines above. The gill opening is reduced to a small opening opposite or above the upper angle of the pectoral base, except in *P. taeniata*, where it is larger and nearly equal to the pectoral base. The dorsal fin is continuous and undivided, but in a few species the first two to four spines may be semi-detached and elongate or filamentous. The dorsal usually ends well before the caudal fin, but in a few species extends to the caudal base. An air bladder is present.

Petroscirtes ***waterousi,*** new species

Dorsal 33 (XII-21); anal 24; pectoral 13; caudal III-9-III.

The depth is 5.5, the head 3.88, the caudal 4.7 times in the length. The eye is 4 times, the snout 3.25 times in the head. The narrow pectoral equals the caudal; the ventral reaches the anus, 4.12 times in the length.

The body is strongly compressed, its breadth 2.4 times in its depth; the width of the head is a little greater, a trifle more than half the depth, or 2.65 times in its own length. The anterior dorsal profile is strongly convex; the eye is high up, in the forward half of the head, the interorbital width less than half an eye diameter. There are 18 teeth above and below, besides a large canine on each side above and below; the lower canines are half an eye diameter in length, the upper ones about half as long and much slenderer. The gill opening is but a trifle larger than the pupil.

The first dorsal is markedly lower than the second, the longest posterior rays 6.6 times in the length or 1.7 in the head; the anal is still lower, its longest rays about 9.4 times in the length, or 2.4 in the head. There are no tentacles.

The color in alcohol is a very pale yellowish gray, without definite markings. There is a nearly vertical dusky line behind the eye, and the snout is dusky, with a dusky stripe on the lower lip; a faint dusky bar extends from the eye to the throat and on up to the other eye. There are faint indications of about a dozen narrow dusky bars from the back downward, across the body. The fins are all without markings. In life the color was apparently golden yellow.

Here described from the type and only specimen, 33 mm. long, taken from a swamp on the Waterous Hacienda, Mangarin, Mindoro, Philippine Islands. Named for Dr. W. H. Waterous, physician and surgeon of Manila, to whose hospitality at Hacienda Waterous I am greatly indebted.

Petroscirtes ***feliciana,*** new species

Dorsal XII-20; anal I-22 or II-22.

The depth is 5.78 to 6.1, the head 4.4, the caudal 5.3 to 5.4 times in the

length. The snout equals the eye, 3.9 to 4.16 times, the post-orbital 1.5 in the head.

The slender elongate body is laterally compressed, its breadth a little less than half the depth; the head is broader, its width 1.3 in the depth. The snout is convex, the eye in the front half of the head. The narrow interorbital space is 2.3 to 3 times in the eye.

The small mouth extends to a vertical from the front margin of the eye, or a little beyond; there are 20 teeth in the upper and 18 in the lower jaw; the stout lower posterior canines are apparently about a third of an eye diameter in length, and the slender upper canines are about half as long as the lower. The mouth could not be opened sufficiently to measure the lower canines, without badly damaging the specimens. There are no tentacles. The dorsal origin is barely in advance of the gill opening, the fin low anteriorly, the rear half higher, not attached to the caudal, the longest rays 5.25 to 5.4 times in the length. The anal is low, its longest rays 8.5 to 9 times in the length. The pectoral is 7 times in the length in the type; the ventral is 5.25 to 5.4 times in the length; the caudal is slightly elongate at the corners.

The color in alcohol is purplish brown, with 12 more or less angulate or vertical dusky brown cross-bars along the middle of the side, followed by two median spots; as in several other species of *Petroscirtes*, there are two longitudinal dusky spots on the caudal base; along the back is a series of irrgular dusky brown spots. Behind the eye is a narrow diagonal blackish bar; a blackish spot on the opercle is bordered above and below by paler, and there is a similar blackish spot on the upper part of the pectoral base. The anterior half of the dorsal has one or two longitudinal dusky bars; between the thirtieth and thirty-second dorsal rays is a pale-margined blackish-brown ocellus; on the posterior part of the anal fin are two or three dusky bars, curving upward and backward; otherwise the fins are all concolorous.

Here described from the type, 55 mm. long, and paratype 45 mm. long, collected in a mangrove swamp beside the Fishery Station at Cagayan, Oriental Misamis Province, Mindanao, Philippine Islands.

This fish is closely related to *Petroscirtes kallosoma* Bleeker, and *Petroscirtes elongatus* Peters, but is markedly distinct from them.

Named in honor of Dr. A. T. Feliciano, of the Zoology Department of the University of the Philippines, the accomplished and amiable assistant assigned to me by the Philippine National Research Council during my 1940 expedition to the Philippines.

Key to the Philippine Species of *Petroscirtes*

(Based on preserved material)

A. Fresh water species, known only from Lake Bombon.
Body with about 9 more or less angulate darker vertical bars; dorsal 32–36; anal 24 ..... 1. *P. ferox*

AA. Marine species.

B. Dorsal with 35 or more rays.

C. Anterior dorsal rays elongated.

D. First 4 elongated, first and second rays much the longest; dorsal 36–38; anal 1–25–27; no tentacles under chin; dark brown band from snout to caudal tip; a blue or silvery stripe below dorsal base . . 2. *P. filamentosus*

DD. First 3 rays more less elongate, fourth shorter than others except 3 last; a pair of flaplike tentacles under chin, another on eyes; other tentacles around opercles, preopercles, and eyes; caudal lunate with age; dorsal 25 to 27; anal 16 to 18 .....3. *P. mitratus*

CC. Anterior dorsal rays not elongate.

E. Dorsal rays over 40; species not blue.

F. Dorsal 44–45; brown band from eye to caudal, with blue or white border stripes; fins clear yellow .....4. *P. rhinorhynchus*

FF. Dorsal 42–43; brown, with median longitudinal band; dorsal with 7, anal with 5 brown vertical bars; caudal crossbarred by brown dots .....5. *P. amblyrhynchus*

EE. Dorsal rays 38–39; blue, with black band from snout to caudal tip; dorsal and anal black, with white margins .....6. *P. taeniatus*

BB. Dorsal with less than 35 rays.

G. No longitudinal bands or stripes.

H. No cross bands or stripes on body.

I. No tentacles.

J. Plain yellow in life; yellowish gray in preservative, with faint indications of a dozen narrow crossbars; fins all clear; dorsal 33; anal 24 .....7. *P. waterousi*

JJ. Olive to yellowish, with small brown spots and sprinkled with blue dots; fins yellow, dorsal and anal spotted and striped with dusky; dorsal 28; anal 19 .....8. *P. bankanensis*

II. Tentacles on eye, throat, nape, and top of opercle; mottled brown, with whitish or blue spots and dots; fins barred with red-brown spots or bands; dorsal 27–30; anal 17–19 .....9. *P. eretes*

HH. Diagonal or angular crossbands on body.

K. An ocellus on dorsal.

L. A large black ocellus between 18th and 24th dorsal rays; 11 angulated black crossbands, angles pointing forward; dorsal 30–32; anal II–18–21 .....10. *P. kallosoma*

LL. A blackish-brown ocellus between the 30th and 32nd dorsal rays; 12 angulate or vertical dusky brown crossbars; dorsal 32; anal I or II–22 .....11. *P. feliciana*

KK. No ocellus on dorsal.

M. 8 white diagonal or curved stripes slanted backward along side, with wider blackish brown stripes between; a large black or dark brown spot behind eye, margined by white lines; opercular opening in dark spot; white-margined brown bands on throat and chin; dorsal 31–33; anal 22–23 .....12. *P. loxias*

MM. 11 angulated black cross bands, the angles pointing forward with a black spot on each angle; dorsal 30–32; anal II–18–21 .....10. Females and young of *P. kallosoma*

GG. Body with one to several longitudinal bands, or stripes.

N. A single broad black or blue-black band from eye to caudal .....13. *P. variabilis*

NN. Body with 2 or more lengthwise bands.

O. Tentacles present.

P. Short broad tentacles on upper part of eye and behind upper rim and a pair of small tentacles on nape; a wide purplish brown band from snout to caudal base; below it a pearly white band and under that a dark brown line from chin to caudal base .....14. *P. polyodon*

PP. A pair of small filamentous tentacles on throat, a minute pair very close together on nape and a

minute pair on upper margin of opercle; a band of short vertical violet-brown bars from eye to top of caudal base; a dark band on dorsal base, merging posteriorly with band below; a dark band, often disappearing, above anal .....
.....15. *P. grammistes*

OO. No tentacles.

Q. A violet brown band over eye to middle and basal third of caudal; a very dark stripe along dorsal base and a brown band from chin to caudal, these converging on caudal to first band; a yellowish-white band from upper rim of eye to caudal and one from upper lip to caudal
.....16. *P. solorensis*

QQ. Bluish to pearl, with 3 wide dark brown lengthwise bands ending before rear end of dorsal; second and third bands are of pale brown, with very dark circular spots as large or larger than interspaces; circular dark spots on caudal peduncle and base; ground color forms bluish or pearly stripes between dark bands .....
.....17. *P. temminckii*

The Distribution of *Petroscirtes* in the Philippines and Adjacent Celebes and Sulu Seas

1. *Petroscirtes ferox* Herre

Known only from Lake Bombon, Batangas Province, Luzon.

2. *Petroscirtes filamentosus* (Cuvier and Valenciennes)

Not yet taken in Philippine waters, but collected by me on the north coast of Celebes. Any marine fish found there undoubtedly occurs in the Sulu Islands and on the southern coast of Mindanao.

3. *Petroscirtes mitratus* Rüppel

Recorded by Fowler from "the Philippines." I have examined 3 specimens from Puerto Galera, Mindoro, 2 from Santa Maria and one from Patalon Plantation, Zamboanga Province, Mindanao.

4. *Petroscirtes rhinorhynchus* Bleeker

I have collected this at Dumaguete, Oriental Negros, and at Sitankai, Sulu Islands.

5. *Petroscirtes amblyrhynchus* Bleeker

I have obtained this from the south coast of Cotabato Province, and at Lembeh Strait and Kema, North Celebes.

6. *Petroscirtes taeniatus* (Quoy and Gaimard)

Occurs on coral reefs throughout, but seldom collected even when commonly seen. Recorded only from Calapan and Puerto Galera, Mindoro; Dumaguete, Oriental Negros; and Bungau, Sibutu, and Sitankai, Sulu Islands.

7. *Petroscirtes waterousi* Herre

Only known from a mangrove swamp near Mangarin, Mindoro.

8. *Petroscirtes bankanensis* Bleeker

The sole Philippine locality recorded is Cabalian, Leyte.

9. *Petroscirtes eretes* Jordan and Seale

Occurs generally through the Philippines. I have seen specimens from Manila, Nasugbu, Batangas Province, and Magallanes, Sorsogon Province, Luzon, Puerto Galera, Mindoro; Culion; Estancia and Iloilo, Panay; Cuyo; Bais and Dumaguete, Oriental Negros; and Sitankai, Sulu Islands.

10. *Petroscirtes kallosoma* Bleeker

I have taken 2 specimens of this at Nasugbu, Batangas Province, Luzon; 14 at Estancia, Panay, and 32 at Patalon Plantation, 30 km. north of Zamboanga, Zamboanga Province, Mindanao. The dorsal ocellus is absent on females and young males, and sometimes is very poorly developed on adult males.

11. *Petroscirtes feliciana* Herre

Only known from a mangrove swamp at Cagayan, Oriental Misamis Province, Mindanao.

12. *Petroscirtes loxias* (Jordan and Seale)

Common in the central and southern Philippines. It has been recorded from Nasugbu, Batangas Province, Luzon; Bais and Dumaguete, Oriental Negros Province; Culion; Mactan Island, Cebu; Kolambugan, Lanao Province, Mindanao; and Sitankai, Sulu Islands.

13. *Petroscirtes variabilis* Cantor

The only Philippine example was taken near Kling, on the south coast of Cotabato Province, Mindanao. I have also taken it from the Sulu Sea near Sandakan, British North Borneo.

14. *Petroscirtes polyodon* Bleeker

The sole Philippine locality is Dumaguete, Oriental Negros Province, where I secured 13 specimens.

15. *Petroscirtes grammistes* (Cuvier and Valenciennes)

This species has been recorded previously from Subic, Zambales Province, Legaspi, Albay Province, and Bacon, Sorsogon Province, Luzon; Puerto Galera, Mindoro; Cebu; and Dumaguete, Oriental Negros Province. In August, 1940, I collected 18 specimens, 22 to 54 mm. in length, in a mangrove swamp beside the Fishery Station at Cagayan, Oriental Misamis Province, Mindanao.

16. *Petroscirtes solorensis* Bleeker

Specimens have been examined from Cabalian, Leyte, Clarendon Bay, Balabac, and South Ubian, Sulu Islands.

17. *Petroscirtes temmincki* Bleeker

The only Philippine locality is Cebu, where 4 examples, 48 to 61 mm. in length, were taken.

NATURAL HISTORY MUSEUM, STANFORD UNIVERSITY, CALIFORNIA.

The Occurrence of Female Sword-fish in Southern New England Waters, with a Description of Their Reproductive Condition [1]

By Richard E. Lee

THE single species of the sword-fish, *Xiphias gladius* Linnaeus, is world-wide in distribution, being found on both sides of the Atlantic and Pacific oceans, in the Indian Ocean, and in the Mediterranean Sea. Therefore, certain common breeding grounds or areas of intermingling and breeding must exist to maintain constant specific characteristics for such a widely distributed species. Such regions are not known. M. P. Fish (1926) reports that spawning sword-fish are found in the Mediterranean Sea during the late spring and early summer, and that sword-fish eggs are sometimes seen on the Sicilian coastline during this time. However, I have been unable to find any other description of the breeding habits, of the sexually ripe fish, or of schools of young sword-fish fry, in the literature on the Mediterranean sword-fish. Lutken (1880) describes several young sword-fish fry captured in the middle of the Atlantic Ocean, suggesting that sword-fish might breed in the deeper waters of the Atlantic basin. There is no further evidence for this idea. Knowledge concerning the reproductive condition or breeding habits of those sword-fish occurring along the eastern American coastline is likewise scanty; for with few exceptions the several papers published on this fish as it is found in these waters are taxonomic descriptions or records of distribution. Thus the life history of the sword-fish is unknown.

This lack of information leaves a wide gap in fisheries data on an economically important food fish, which would prove serious should conservation measures ever be necessary. Declining yearly catches of sword-fish along the southern New England coastline indicate that such might be the case in the future. In studying the life history of any fish, the locating of its breeding grounds is of prime importance. Once this is done, further work concerning the various phases of the problem are greatly facilitated. Such a method was used by Schmidt in his memorable work on the eel. Unfortunately, the apparent lack of spawn or numbers of sword-fish fry in the oceans prohibits the use of tow-nets in locating spawning areas. The next best approach to the problem seems an extensive study, world-wide if possible, of the reproductive glands and their state of sexual development in the adult fish, in all portions of its range. Such a study should reveal an area or areas where the sword-fish are at a stage of maximal reproductive activity. Further work in such regions could be intensified until the actual breeding grounds were located.

With this plan of attack, an anatomical and cytological examination of the reproductive organs of those sword-fish found off the southern New England coastline was begun in the summer of 1941. With the aid of several commercial fishing boats, gonads were obtained from 13 sword-fish during the

[1] Woods Hole Oceanic Institute, Contrib. 304.

summer, captured in an area extending eastward from Block Island to George's Bank, and from approximately 20 to 100 miles offshore from Woods Hole, Massachusetts. The method of obtaining the gonads was simple. Large canisters, containing 10% formalin, were placed aboard the fishing vessels prior to a trip to the grounds. Upon capturing a fish, the reproductive glands were removed, slashed open to facilitate penetration of the preservative, and placed in the container. When the vessel returned to Woods Hole after a successful trip, the canister was exchanged for a fresh one and the gonads were brought into the laboratory at the Oceanographic Institute for examination.

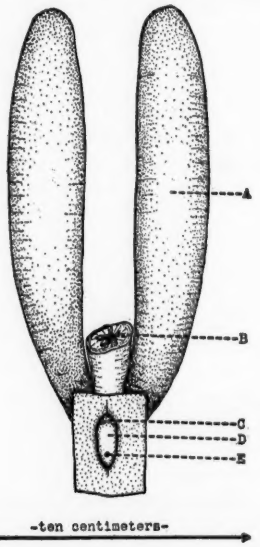

Fig.1. Ventral view of the ovaries of *Xiphias gladius* L. A—ovary; B—severed end of bowel; C—anus; D—genito-anal prominence; E—genital pore.

Strangely enough, all of the sword-fish proved to be female. This fact, evident at preliminary examination, was verified in each instance by microscopic study of sections of the gland. The ovaries are relatively long sausage-shaped structures, from 15 to 35 cm. in length (fig. 1.), and from 4 to 10 cm. in diameter. The smallest pair of ovaries weighed 461 gm., while the largest pair weighed 1623 gm. The smallest sword-fish captured weighed 52 kg., while the largest sword-fish captured weighed 137 kg. The size of the ovary varies directly with that of the fish. The ovaries lie on either side of the midline, and extend posteriorly to fuse with one another in the midline at a point that is posterior to the descension of the intestine into the rectum. Here they are bound to the rectal region of the bowel by heavy tissue sheaths. This junction is one of position alone, however, for the very short oviducts fuse and open to the exterior by means of a single genital pore that is found

in the mid-ventral line about a centimeter posterior to the anus. These two openings, the anus and genital pore, are located in a flattened ovid structure, delimited from the surrounding region by integumentary folds, which I have called the "genito-anal prominence" for want of an authentic name.

The ovary possesses a lumen, with the internal ovarian wall thrown into the deep longitudinal folds described by Fish (1926), which project into the lumen to branch extensively and bear the ova. The lumen of each ovary opens into a short oviduct; these fuse to form a single duct extending to the genital pore described above. The ova are microscopic in size, ranging from 24 to 180 micra in diameter, regardless of the size of the ovary, with some evidence of size classes present. They are extremely numerous, no accurate determination of the numbers present being possible.

The most significant fact revealed by this study of the sword-fish gonads is that all of the fish captured throughout the summer from a large fishing area were female. If the sword-fish are distributed evenly with regard to the numbers of each sex present, there is only a $.5^{13}$ chance of capturing all of any one sex, in 13 individuals. This is far beyond the realm of probability. The absence of any other report on the distribution of the sexes of the sword-fish with which to compare the results of the past summer's work prohibits the forming of a definite conclusion, but it seems that some type of sexual segregation or an extremely high ratio of female to male fish exists.

There are other factors, however, that one must consider, and these necessitate extensive research. The methods used in capturing sword-fish result in securing only those fish at the surface of the sea. The females may be chiefly surface dwellers in warm weather, with the males remaining in deeper water and seldom approaching the surface. Such a condition is not known to exist; if it does, it would result in an exclusively female catch. Also, many fish are missed by the fishermen, due to a highly elusive or restless nature that makes it impossible for the vessel to approach them on the surface. These fish may be males, too wary to be caught. Such circumstances are extremely unlikely, but at least must be considered, because of the unusual results of the past summer's work. In view of the number of fish obtained, a possible segregation of the sexes of the sword-fish in southern New England waters may exist. Further investigations on the sexual distribution of this fish are certainly warranted.

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Woods Hole Oceanographic Institute, and Biological Laboratories, Harvard University, Cambridge, Massachusetts.

Length-Weight Relationship, Age, Sex Ratio and Food Habits of the Smelt (*Osmerus mordax*) from Crystal Lake, Benzie County, Michigan

By William C. Beckman

A REVIEW of the literature on the smelt reveals a lack of knowledge of the length-weight relationship. In order to add some information on this subject, Dr. John Van Oosten, of the United States Fish and Wildlife Service, and Dr. A. S. Hazzard, of the Michigan Institute for Fisheries Research, collected data on the length, weight, sex and sexual maturity of smelt caught by hook and line in Crystal Lake, Benzie County, Michigan, on February 29, 1940, and February 20-21, 1941. Scale samples were also taken and a cursory field determination of the stomach contents was made by the collectors. On June 12-21, 1940, some additional specimens were collected by means of gill nets (2 to 4 inch stretched measure) and a 100-foot bag seine (¾ inch stretched measure) from the same lake by a lake inventory party of the Institute. The scale samples and data were turned over to the writer for analysis and compilation.

The smelt in Crystal Lake are descendants of the original stocking made in 1912. The eggs which were planted were obtained from the hatchery at Green Lake, Maine. From Crystal Lake the smelt have spread throughout most of the Great Lakes drainage (except Lake Ontario).

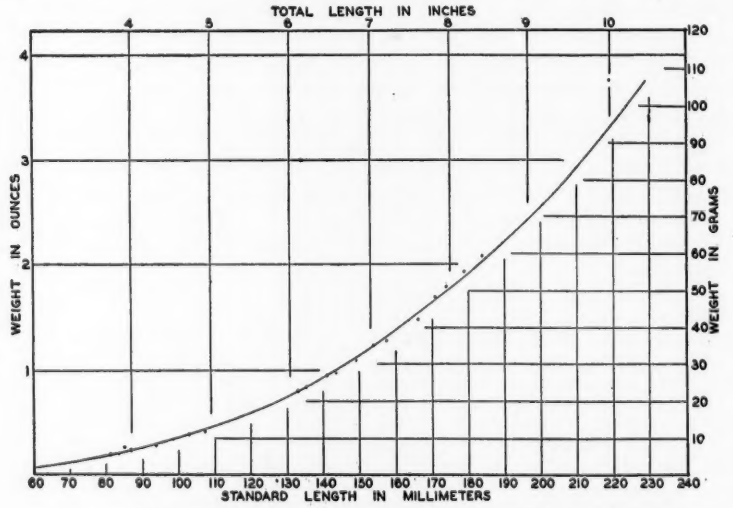

Fig. 1. Length-weight relationship of the smelt of Crystal Lake, Michigan.

Length-Weight Relationship

Figure 1 shows graphically the length-weight relationship. The dots repre-

sent the empirical averages of the standard length and weight (the data were tabulated originally by 5-millimeter intervals of total length). The smooth curve is the graph of the parabola whose logarithmic form is,

$$\log W = -4.59918 + 2.8095 \log L,$$

where W = weight in grams,

and L = standard length in millimeters.

The equation was derived by fitting a straight line to the logarithms of the average lengths and weights of the smelt. The value 2.8095 shows that the weight of the smelt increases at a rate somewhat less than the cube of the length. Figure 1 has been so arranged as to permit ready conversions from standard lengths in millimeters and weights in grams to total lengths in inches and weights in ounces.

TABLE 1

AGE AND SIZE OF THE SMELT FROM CRYSTAL LAKE, MICHIGAN

Month and year of collection	Number of fish	Sex	Age-group	Average standard length in millimeters	Average total length in inches	Average weight	
						grams	ounces
June 1940	10	Unknown	I	92	4.2	8	0.28
June 1940	1	Male	I	133	6.1	23	0.80
June 1940	1	Female	I	107	4.8	12	0.42
Feb. 1940	23	Male	II* [1]	152	6.9	34	1.20
June 1940	6	Male	II	150	6.9	31	1.09
Feb. 1941	15	Male	II*	152	7.0	34	1.20
Feb. 1940	30	Female	II*	155	7.1	36	1.27
June 1940	8	Female	II	152	6.8	36	1.27
Feb. 1941	10	Female	II*	154	7.1	34	1.20
Feb. 1940	15	Male	III*	164	7.5	42	1.48
June 1940	4	Male	III	167	7.7	45	1.59
Feb. 1941	21	Male	III*	164	7.6	41	1.44
Feb. 1940	25	Female	III*	174	7.8	51	1.80
June 1940	1	Female	III	193	8.7	71	2.50
Feb. 1941	34	Female	III*	172	7.8	50	1.76
Feb. 1941	5	Male	IV*	175	7.8	52	1.83
Feb. 1940	4	Female	IV*	182	8.2	56	1.98
Feb. 1941	26	Female	IV*	180	8.3	58	2.04
Feb. 1941	1	Male	V*	174	8.1	54	1.90
Feb. 1941	1	Female	V*	184	8.4	61	2.14

[1] The asterisk after the age numeral indicates that the age exceeds by one the number of annuli observed on the scales. The fish had presumably finished the year's growth by February but the annulus would not be formed until more rapid growth was resumed in the spring.

RELATIONSHIP BETWEEN STANDARD LENGTH AND TOTAL LENGTH

The various factors for conversions between standard and total length, with and without change in units of measurements, are as follows: The factor, based on 241 specimens, for the converting, without change of units of length, from total length to standard length is 0.858; for converting standard length to total length, 1.165. The factor for converting standard length in millimeters to total length in inches is 0.045866; for converting total length in inches to standard length in millimeters, 21.79. These factors were not found to vary significantly with the length of the fish, most of the 5-millimeter intervals from 80 to 230 millimeters standard length being represented.

Average Length and Weight of the Age-Groups

The smelt grew most rapidly in both length and weight during the first two years of life (Table 1). The sex difference in the rate of growth was very small, although the females exceeded the males slightly, especially in age-group III.

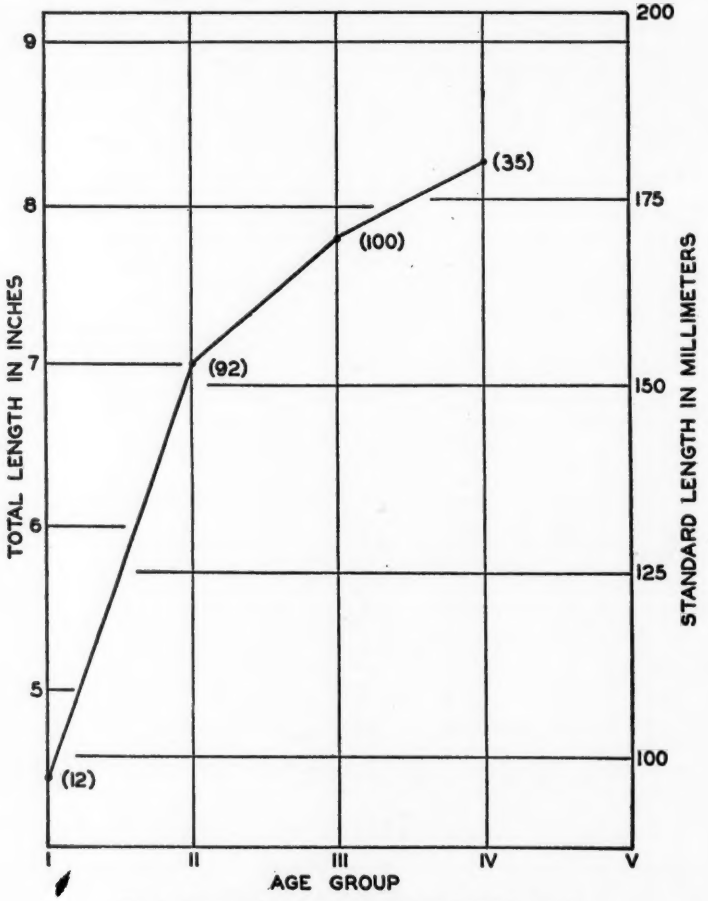

Fig. 2. Average size of age-group of Crystal Lake smelt.
(Number of specimens in parentheses.)

The smelt in Crystal Lake averaged 4⅜ inches (total length) at the end of the first year, 7 inches at 2 years, 7¾ inches at 3 years, 8¼ inches at 4 years (Fig. 2). Creaser (1929) found the average standard length of smelt from the same lake to average 92 mm. at 1 year, 156.9 mm. at 2 years, and 171 mm. at 3 years.

Metzelaar and Langlois (unpublished manuscript) measured a large number of smelt from Crystal Lake in 1928. The average lengths of their sample also agree very closely with those obtained in 1940 and 1941. It appears that little change has occurred in the rate of growth of the smelt in Crystal Lake.

The rate of growth of the smelt is slower in Crystal Lake than in Green Bay or Lake Erie. In Green Bay the smelt averaged 7 inches in length in the second year, 10 inches in the third year, 12 inches in the fourth year, and 14 inches in the fifth year (Schneberger, 1937), whereas in Lake Erie the length of 5 two-year old smelt varied from 8.1 to 9.4 inches (Van Oosten, 1940). All of the above are total lengths.

Sex Ratio

Most of the published data on the sex ratio of smelt were based on spawning-run samples. Various workers have shown that the proportion of males and females changes during the breeding season, and even during the same night. Males are usually dominant at the beginning of the run. Thus the sex ratio would vary greatly according to the time the sample was taken.

Table 2

Sex Ratio of the Smelt from Crystal Lake, Michigan

Month and year of collection	Age-Group	Number of males	Number of females	Ratio (females per 100 males)	Percentage of males	Percentage of females
June 1940	I	1	1	100	50	50
Feb. 1940	II*[1]	23	30	130	43	57
June 1940	II	6	8	133	43	57
Feb. 1941	II*	15	10	67	60	40
Combined	II	44	48	109	48	52
Feb. 1940	III*	15	25	166	38	62
June 1940	III	4	1	25	80	20
Feb. 1941	III*	21	34	162	38	62
Combined	III	40	60	150	40	60
Feb. 1940	IV*	0	4	F[2]	0	100
Feb. 1941	IV*	5	26	520	16	84
Combined	IV*	5	30	600	14	86
Feb. 1941	V*	1	1	100	50	50
All collections combined		91	140	154	39	61

1 See footnote of Table 1.
2 All females.

The data presented here (Table 2) were taken from sexually mature fish caught by hook and line during the winter, about 6 weeks before the beginning of the spawning season, and from the sexually mature fish taken in gill nets and bag seine in June, after the spawning season.

The females were dominant in all well represented age-groups except age-group II taken in February, 1941, and age-group III collected in June, 1940. The relative abundance of the females increased progressively with increase in age. The sex ratio of the combined collections was 154 females (61 per cent) to 100 males.

Food Habits

The stomachs of the smelt caught in February 1940 and 1941 were examined (Table 3). Of the 210 stomachs examined, 122 (56 per cent) were empty. All recognizable fish were minnows (*Notropis* sp.). Specific identification was made on 5 Lake Emerald shiners (*N. atherinoides*), and one spottailed shiner (*N. h. hudsonius*). One stomach contained a fish that appeared to be a small smelt, but positive identification could not be made. As minnows were used for bait, a distinction was made between bait minnows and non-bait minnows found in the stomachs. Bait minnows usually could be recognized by hook marks. It is possible that some bait minnows which had been digested beyond the point at which hook marks could be detected may have been classified erroneously as "non-bait." Twenty-five per cent of the 210 stomachs contained non-bait minnows, and 15 percent contained bait. Unidentifiable fish remains and other food were found in 4 per cent of the stomachs.

Table 3.

Contents of 210 Stomachs from Smelt from Crystal Lake, Michigan

Date	Number of stomachs empty	Number of stomachs containing			
		Bait minnows	Non-bait minnows	Unidentifiable fish remains	Other food
Feb. 29, 1940	55	2	37	3	2 (1 scud) (1 eggs)
Feb. 20, 21, 1940	67	31	18[1]	4	1 (mayfly)
Total	122	33	55	7	3

[1] Two possibly contained bait.

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Ichthyological Notes

FUNDULUS PALLIDUS ON THE FLORIDA GULF COAST.—In studying the roseate spoonbill on the Gulf Coast in 1939–41, Mr. Robert P. Allen of the National Audubon Society made considerable collections of the small fishes found on the feeding grounds of this bird on the west coast of Florida, and submitted them to the American Museum of Natural History for determination.

One of the species taken most abundantly is a *Fundulus* which I cannot distinguish from *F. pallidus* Evermann (1892, Bull. U. S. Fish Comm., 11: 84, Pl. 35, fig. 2, Galveston Bay, Tex.), and, provisionally at least, must identify with that form.

It was found rather generally distributed in the habitats collected. The greatest number are from Alligator Cove, but it was also taken at Bird Key Bight, Duck Rock, Bottlepoint Key Ponds, Butternut Key, Manatee Keys, East Cape Canal and Ponds,—93 specimens examined of from 13 to 49 mm. standard length.

Fundulus similis (Baird and Girard) was less plentiful, represented by only 26 specimens, 25 of 20 to 33 mm. and one of 80 mm. Ten were taken with the more numerous (53) *F. pallidus* at Alligator Cove. From Bird Key Bight *similis* outnumbered *pallidus,* 9 specimens to 4. There are 7 specimens from Dove Creek Slough, Key Largo, whence *F. pallidus* is not represented.

These two species, when of comparable small size, are very similar. The two are obviously related and both are variable, so that they more or less intergrade. However, using the characters for their determination given by Jordan and Evermann (1896, 1900, Bull. U. S. Nat. Mus., 47: 634, 638–9, Fig. 272) I have had no hesitation in placing any specimen, on the basis of the larger eye, and blunter, shorter snout of *pallidus.* At 20 mm. the eye of *similis* may equal snout; above that size to 33 mm. it is 1.1 to 1.5 and in the 80 mm. specimen 2 in snout. From 15 to 22 mm. the eye of *pallidus* is 0.8 to 0.9, from 24 to 49 mm. 0.9 to 1 in snout.

The black blotch in the mid-line of the back in front of the dorsal fin does not hold as a difference. It is almost always present in *pallidus,* but also frequently present in *similis.* Small *similis* usually have whiter sides, the cross-marks narrow, black, and sharply defined. Some of the smaller *pallidus* have whitish sides and sharp narrow cross-marks; but specimens of this form tend to be pale and grayish, most of their markings suffuse, the cross-marks on the sides faint or broader.

Thirteen specimens of *Fundulus,* 10 from Pink Curlew Flats, Bird Key Bight and East Cape Canal; one from East Cape Ponds, and 2 from Alligator Cove, are evidently a form of *Fundulus heteroclitus* (Linnaeus). They range from 35 to 68 mm. in standard length and approximate the adult colors of that species, as well as being close to it in technical characters. The largest, of 65 and 68 mm., are somewhat deep-bodied and compressed for *heteroclitus,* and seem to be fully grown. They are not *F. h. grandis* Baird and Girard, recognized from the Gulf Coast. On the other hand a single specimen 60 mm. long, collected by Mr. Allen at Mustang Lake, Texas, looks like the *F. h. grandis* I have seen from Florida.

Comparison of these specimens referred to *heteroclitus* ssp. with the mostly smaller ones referred to *pallidus,* convinces me that the two lots represent forms which are exceedingly close and intergrade, or very likely are undifferentiable. A reason for provisionally considering them distinct is a slight habitat difference. The few specimens referred to *heteroclitus* ssp. are scattered among the mainland localities, and there are none from out on the keys, and this is the only form of *Fundulus* represented from Pink Curlew Flats, the most inland station. It would be logical to suppose a brackish water form or close relative of *heteroclitus,* grading into *pallidus* at the coast, and that in turn intergrading or hybridizing with *similis.*

This group of *Fundulus* is probably in need of a thorough revision which our limited material, mostly young fish, does not warrant. The specimens referred to *pallidus* are quite unlike young *heteroclitus* from Maine to North Carolina, but I am not familiar

with the young of that species from Florida and the Gulf Coast. We should also bear in mind that the type locality of *pallidus* is in Texas, not Florida.

It will be of interest to compare the habitat distribution of our *F. pallidus* and *F. similis*. Consider first, the collecting stations which lie in Florida Bay opposite Key Largo, i.e., Bottlepoint Key Ponds, Butternut Key, Manatee Keys, East Cape Canal and Ponds, (these last with tidal current, otherwise non-tidal): water muddy; soft marly mud bottom, mixed with rotting leaves, etc. at Butternut Key, with shell in East Cape Canal, with a growth of turtle grass at Manatee Keys and some grass at Butternut Key; otherwise essentially without vegetation; salinity varying from 20.6 to 32.0 (in parts per 1,000). *F. pallidus* was taken at all these stations, though not many, 31 in all, 15 of them in East Cape Canal (salinity 24.1) in August, 8 in Bottlepoint Key Ponds (average salinity 32.0) in February. We have no *F. similis* from any of these stations. On the other hand we have *Fundulus similis* and no *F. pallidus* from Dove Creek Slough, Key Largo, the semi-tidal head of a creek entering from the Atlantic, clear water, calcareous rock and silt bottom with many black mangrove quills, salinity 25.1. "There is considerable fluctuation in Florida Bay salinities." Thus at Bottlepoint Key Ponds, average 32.0, "when many collections were made in January and February, 1941, the salinities reported varied from 24.0 to 29.8."

Consider next three stations up the coast north of Lostmans River, facing the Gulf, with tidal water and no appreciable aquatic vegetation. Duck Rock is exposed; calcareous rock and muddy silt bottom, clear water, salinity 24.5. Bird Key Bight and Alligator Cove are protected, with soft mud and broken oyster shell bottom, very muddy water, salinities respectively 25.7 and 27.4. Bird Key Bight is less protected than Alligator Cove. *Fundulus pallidus* was taken at all these stations, but in greatest abundance in Alligator Cove. We have 53 specimens (43 in May, 10 in July) from there, only 9 from the other two localities together. There are 10 *F. similis* from Alligator Cove, 9 from Bird Key Bight where it outnumbers *F. pallidus*, none from Duck Rock whence there are 5 *pallidus*. This reverses what might have been expected by deducing from specimens taken about Florida Bay, that *similis* was more an open water, *pallidus* more a sheltered water form. It may be that *pallidus* is the more abundant and generally distributed on this stretch of Gulf Coast, *similis* only to be expected at stations particularly favorable for *Fundulus*.

The remaining station, Pink Curlew Flats, is one of sheltered, very muddy tidal water, with soft mud and shell bottom and no appreciable vegetation, salinity 24.1, further north, well back of Cape Romano. The only *Fundulus* from here is *F. heteroclitus* ssp., as above.—J. T. Nichols, *American Museum of Natural History, New York.*

THE OCCURRENCE OF FLOUNDER POST LARVAE IN FISH STOMACHS.—During part of the summer of 1931 I made beach seine hauls at points in western Alaska for the International Fisheries Commission. Hauls taken June 30 on a flat light-colored sandy beach in Northeast Harbor, Little Konuiji Island, one of the Shumagin Islands, caught a large number of dolly-varden trout (*Salvelinus malma*), together with a number of flounders, *Lepidopsetta bilineata* and *Platichthys stellatus*. The flounders were used in connection with meristic studies, and the stomach contents from about 50 specimens of the *Salvelinus* were preserved in formalin after it was observed they contained specimens of young fish. Some of the flounders which were preserved in formalin were also later found to contain small fish in their stomachs.

One hundred and twenty post larvae of a small mouth flounder were taken from the stomachs of the dolly-varden examined and as many as 12 were taken from a single stomach. These have recently been identified by establishing a characteristic pigment pattern through the series of specimens and by comparison of the number of fin rays with those of adults (Townsend, Lawrence D., International Fisheries Commission Report No. 11) and prove to be *Lepidopsetta bilineata*. The condition of most of the specimens when recovered from the stomachs was good, with the specimens usually possessing the larval pigment in the skin. Specimens varied from 9 to 15 mm. in standard length. Stomachs of the dolly-varden were also found to contain large numbers of larvae of the sand launce, *Ammodytes tobianus*, varying from 22 to 55 mm. in length. These observations are of interest in that Allan C. Delacy (University Washington Thesis No. 4536) has shown that dolly varden stomachs contain a low percentage of fish remains in fresh water.

Later examination of the stomach contents of some of the preserved flounder specimens revealed that *Lepidopsetta bilineata* was also feeding on post larval flounders of the same species, as well as small unidentified cotids.—LAWRENCE D. TOWNSEND, *834 Miner Building, Eugene, Oregon.*

A NOTE ON THE DOLPHIN (*CORYPHAENA HIPPURUS*) AND THE METHOD OF ITS CAPTURE BY THE ANCIENTS.—Beebe (Arcturus Adventure, 1926: 67) remarks upon the concentration of fishes of various species around floating objects, saying, "From the deck, looking directly down, we could watch closely the fish which crowded beneath every log, or stick, or nut." Baughman (COPEIA, 1941(2): 117) records such a concentration of small dolphin (*Coryphaena hippurus*) about driftwood and other flotsam.

This trait was evidently known to the ancients, and they took advantage of it in a most interesting and ingenious manner to aid in the capture of these fish. For details of this we are indebted to Oppian (Halieutica, Loeb Library, New York, 1928: 433, 435), whose little known description well merits repetition for the benefit of those unfamiliar with the quotation.

"The Hippurus," he says, "when they behold anything floating in the waves, all follow it, closely in a body, but especially when a ship is wrecked by the stormy winds, finding Poseidon terribly unkind and the great waves break her up and carry hither and thither her scattered timbers, loosened by the rending assaults of the sea. Then the shoals of the Hippurus follow in the train of the drifting planks, and the fisherman who chances upon them wins easily great and unstinted spoil. But that may the Son of Cronus, the lord of the deep avert from our sailors, and may their ships speed over the broad waves with gentle breezes, unhurt and unshaken, while they ply to and fro for cargo! And for the Hippurus men may contrive other devices and without the wreck of ships pursue their prey.

"The fishermen gather reeds and tie them together in bundles which they let down into the waves, and underneath they tie a heavy stone by way of ballast. All this they let sway gently in the water; and straightway the shadeloving tribes of the Hippurus gather in shoals and linger about, delightedly rubbing their backs against the reeds. Then the fishers row to them to find a ready prey, and bait their hooks and cast them, and the fish seize them, hastening therewith to their own destruction. . . . And easily, if active, thou shalt catch and land them one after the other; for they are more eager than the fishermen themselves and by their own folly hasten their doom."—J. L. BAUGHMAN, *311 Peden Ave, Houston, Texas.*

Herpetological Notes

NEW RECORD FOR *SALVADORA LINEATA*.—A specimen of *Salvadora lineata* Schmidt in my private collection considerably extends the known range of this species, as stated by Schmidt (1940, Field Mus. Nat. Hist. Zool. Ser., 24: 150), to the northward. This specimen, No. PA1593, a female, was collected September 19, 1939, at Palo Pinto, Palo Pinto County, Texas. It measures 740 mm. in total length, tail length 183 mm. Posterior chin shields in contact; supralabials 8-8; infralabials 9-9; ventrals 193; caudals 87. It has the diagnostic lateral line on the third scale row anteriorly and the second posteriorly.—PAUL ANDERSON, *604 W. College St., Independence, Missouri.*

RING-NECKED SNAKES IN MINNESOTA.—Recent accounts of the ranges of ring-necked snakes do not include Minnesota in the range of the genus. Cope, in "Crocodilians, Lizards and Snakes of North America" recorded a specimen (USNM No. 7288) of *Diaphophis punctatus* from "Minnesota." Dr. Doris Cochran writes me that this is a mistaken reading of a label marked "Mississippi." Dr. Blanchard had identified this specimen as *D. p. stictogenys*.

The following records are of interest as the first authentic finds of ring-necked snakes in Minnesota. A specimen definitely referable to *Diaphophis punctatus edwardsii* was collected by H. L. Gunderson on July 23, 1940, near Lax Lake, Lake County, in the coniferous region north of Lake Superior. This is in Minnesota Museum of Natural History No. 1065; a male; length 424 mm., tail 89 mm.; ventrals 157, caudals 59, scale rows 15; belly with a few tiny irregularly placed black dots, neck ring complete. This specimen indicates that the range of this snake may be continuous southwestward around the end of Lake Superior and eastward into northern Wisconsin where it is known to occur. There appear to be no records north or east of Lake Superior in Ontario.

A female specimen of *D. p. edwardsii* was found DOR on June 23, 1941, by W. J. Breckenridge and H. L. Gunderson, near Maiden Rock, Pierce County, Wisconsin, on the shore of Lake Pepin. This is directly across the Mississippi River from Goodhue County, Minnesota. The environment at this place includes limestone and sandstone bluffs, with hardwood forest. This is No. 1134; a female containing four eggs; length about 398 mm., tail 79 mm.; ventrals about 162, caudals 51; belly with a few tiny black dots, neck ring complete.

A ring-necked snake clearly referable to *D. p. arnyi* Kennicott was taken by W. J. Breckenridge, G. N. Rysgaard, and H. L. Gunderson in western Winona County, Minnesota, on August 16, 1941, in the heavy deciduous forested bottom lands of the Whitewater River. It is No. 1143; a female; length 502 mm., tail 57 mm.; ventrals 168, caudals 42, scale rows 17–15; belly heavily marked with a double row of large black dots from neck to anus, neck ring complete. This specimen was from a point only about 35 miles southeast of the above Wisconsin record of *D. p. edwardsii*. These two locality records indicate the meeting of the ranges of these two forms in this area.—W. J. Breckenridge, *Minnesota Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.*

A LARGE HOG-NOSED SNAKE FROM MINNESOTA.—What may be the largest specimen of an eastern hog-nosed snake, *Heterodon contortrix contortrix* Linnaeus, was taken by a state warden of the Minnesota Conservation Department near the town of Moose Lake, northern Pine County, July 1, 1940. Our specimen is No. 1062, Minnesota Museum of Natural History. It is a female with the following measurements: total length 1092 mm. (about 43 inches), tail 165 mm., head length from back of parietals to snout 27 mm., length of ventral plates at mid-body 50 mm., weight 1191 g. (about 2 lbs. 10 oz). The arrangement and number of the head plates seem to be normal for the species. Oculars 10-11, upper labials 8-8, lower labials 11-10. Ventrals 136, caudals 41, scale rows 25-21-17. The reduction from 25 to 19 scale rows occurs within a short space of about 5 inches near mid-body.

The specimen is plain dark gray with a prominent dark blotch on either side of the neck, and a second pair of blotches farther back faintly discernible. It contained the remarkable number of 61 eggs, nearly uniform in size, and measuring about 25 mm. by 17 mm. Schmidt and Davis (Field Book of Snakes: 118) give 42 inches as the maximum length for this species.—W. J. Breckenridge, *Minnesota Museum of Natural History, University of Minnesota, Minneapolis, Minnesota.*

HYLA SQUIRELLA IN KENTUCKY.—In the early afternoon of August 13, 1941, while visiting the Kentucky Woodlands National Wildlife Refuge in Lyon and Trigg counties, I collected a single specimen of *Hyla squirella* Latreille, a species apparently heretofore unrecorded from Kentucky.

The frog was collected from the ground in the midst of a dense growth of weeds near a small stream in Barnes Hollow, Trigg County, just above Hematite Lake. It was discovered quite by accident, in a patch of weeds which averaged over 6 feet in height, into which I had gone to observe a covey of young quail. A single small frog was noticed hopping about on the ground, which proved to be *Hyla squirella*.—Roger W. Barbour, *Dept. of Conservation, Division of Game and Fish, Frankfort, Kentucky.*

ADDITIONAL RECORDS FOR WASHINGTON SNAKES.—*Hypsiglena ochrorhynchus* Cope was first reported in the state of Washington by Svihla (COPEIA, 1940: 52), who secured a single specimen from Vantage Ferry, Grant County. Three more specimens were taken alive within a few hours, at the same site, on June 10, 1941. These prove that this reptile is an established resident of the area. The snakes were found under decayed logs on the stony river flats of the Columbia. In the laboratory, as well as in the collecting sack, they fed willingly on *Uta stansburiana*.

To date, *Lampropeltis multicincta* (Yarrow) has also been known in the state from a single record. Johnson (1939, Occ. Pap. College of Puget Sound, 1–5: 2) described a dead specimen found on the highway near Bingen, Klickitat County. A living specimen was taken on June 20, 1941, by W. W. Dalquest, a quarter mile north of White Salmon, in the same county.

The specimens are to be deposited in the vertebrate collections of the Department of Zoology, University of Washington.—THOMAS H. LEWIS, *University of Washington, Seattle, Washington.*

THE WESTERN SPADEFOOT TOAD IN BRITISH COLUMBIA.—While on a recent field trip through the Okanagan Valley of British Columbia, observations were made on the distribution and life history of the western spadefoot, *Scaphiopus hammondi* Baird, in that area.

On the evening of May 20, 1941, at Osoyoos, B.C., spadefoot toads were heard calling from several points. On investigating a chorus which seemed to be nearest to the camp, toads were found along a swampy portion of the shore of Osoyoos Lake sitting in water-filled depressions made by the hooves of cattle in the soft ground. The Pacific tree-toad, *Hyla regilla*, was also present, but no eggs or tadpoles of either species were found. After dark of the following two days, 5 spadefoot toads were collected in a dry stream bed several hundred yards from the lake, all apparently headed toward the water. Each morning large numbers of fresh tracks were observed on sand dunes a half-mile from the lake shore, but their random nature indicated that they were made by toads foraging for food rather than by individuals migrating toward the lake. At this time moisture was present 6 inches beneath the surface of the sand.

On May 29 large numbers of mature tadpoles of this toad were found in a shallow pond between the highway and the lake. Many of the larvae had well-developed hind-legs and at least one had forelimbs as well. Spadefoot toads were also heard calling at Oliver on May 30 and at Penticton the following night.

This amphibian has not hitherto been reported north of Vernon, near the north end of Okanagan Lake (Fannin, Batrachia of British Columbia; a preliminary catalogue of the collections of Natural History and Ethnology in the Provincial Museum, 1898: 58). A single specimen was collected by Mr. George P. Holland, Dominion Entomological Branch, on June 29, 1937, at Kamloops which is about 70 miles north-west of Vernon, and on June 5 and 6, 1941, Dr. I. McTaggart Cowan, accompanied by the writer, collected 14 more at Mission Flats, 3 miles west of Kamloops. One of this lot was found on the road near water; the remainder were collected in a temporary pond. Of these, three pairs were in amplexus, the clasping position being inguinal as is typical of toads of this family. One male when collected was clasping a female *Hyla regilla* which died soon after, apparently from rupture of the abdominal wall. Eggs of *Scaphiopus* were also collected from the same pond.

These Kamloops specimens provide the northernmost known record for this species, and probably represent the northern extremity of its range.—G. CLIFFORD CARL, *Provincial Museum, Victoria, British Columbia.*

OBSERVATIONS ON *SCELOPORUS OCCIDENTALIS OCCIDENTALIS*.—In June, 1940, I was able to observe a group of *Sceloporus o. occidentalis* on Rattlesnake Island, Clear Lake, Lake County, California, for a period of three weeks. Several times they were seen jumping from a limb to catch an insect. On one occasion I saw one jump from a limb of an oak 13 feet above the ground to catch a moth that was flying 3 feet out from the limb. The drop of 13 feet did not seem to bother the lizard at all.

On numerous occasions I saw these lizards moving about after dark. One night shortly after midnight I turned my flashlight in the direction of a rustling noise and saw a male *Sceloporus* pursuing a female.—NED W. STONE, *2418 California St., Berkeley, Calif.*

REVIEWS AND COMMENTS

BOOK OF BAYS. By William Beebe. xviii + 302 pp., 33 pls. Harcourt, Brace and Co., New York. 1942. $3.50.—This book was born of a cruise on Templeton Crocker's "Zaca" in the winter and spring of 1937–38, along the coast from San Diego to Colombia. It was a leisurely and extended cruise, during which the author, John Tee-Van, Jocelyn Crane and the owner and crew of the "Zaca" made a magnificent collection of fishes and marine invertebrates—in fishes, at least, the finest ever made by one expedition on the Pacific shores of Central America. But the book does not say this. It tells of the bays, their inhabitants, and their creatures, in the style to which Will Beebe's readers have grown accustomed. There is even the photo of a booby, trade-mark familiar of the books of the yacht-ride boys. There are no sensational discoveries announced, no bathyspheres, no "hundred-hours" observations, but there is much of ichthyological interest. Some will call the book a pot-boiler. It is. But I never saw a pot-boiler of Beebe's that wasn't worth reading.

This book would deserve no further words were it not for a faint nostalgic odor that arises as its pages open. The reviewer was on these waters, in these bays, at the same time Beebe was. He has sailed on the "Zaca" and he knew her sleek beauty, her fine cuisine, and her excellence as a collecting ship. Those things are now of another world. The *Book of Bays* may be the last any of us will ever see of the yacht-ride books and their booby-birds. And that may be more ominous than it seems.—GEORGE S. MYERS, *Stanford University, California.*

UNDER THE SEA WIND; A NATURALIST'S PICTURE OF OCEAN LIFE. By Rachel L. Carson, illustrations by Howard French. Simon and Shuster, New York, i–xix, 1–314.—Biology is such a beautiful and awe-inspiring subject, so filled with interesting material, that many people who earn their living by it are tempted to write a book about it, preferably a popular book so as to share with the public their knowledge of Nature. Unhappily these books frequently turn out badly. Often they suffer from what we may call the wee-wee style of writing—the wee birds and the wee flowers; often they are wretchedly dull, and very often indeed they are obnoxiously condescending.

Take the subject of Marine Biology as an example. Almost as vast as the ocean itself, it poses very difficult problems to the writer of popular literature. The book must be brief enough to sustain the reader's attention; yet it must cover its intricate subject adequately enough to make the reader feel that he has not merely learned something, but that he has read something that has never been said before in just that way.

Rachel Carson has produced a book, in *Under The Sea Wind,* that meets these requirements in a most ingenious and engaging way. Through her colorful, poetic descriptions, we are permitted to observe the world of the ocean and the shore as though we lived there as part of those environments. Sea-side and ocean geography, weather, hydrography and biology are all given a reality far surpassing that possible in any technical book, however "popular" its style. Although literary, poetic, and imaginative in treatment, the book is based on sound facts, so that even the most captious biologist is not likely to quarrel with its statements. The illustrations are as beautiful and as charming as the book.—LIONEL A. WALFORD, *Stanford University, California.*

BOOKS RECEIVED

THE MICROBE'S CHALLENGE. By Frederick Eberson. The Jacques Cattell Press, Lancaster, Pa., 1941: i–viii, 1–334, $3.50.—This is an account, in non-technical language, of the principles and history of Bacteriology. An informative book, interesting and entertaining for the most part, though at times condescending in a strained effort to be popular.

ABOUT OURSELVES. By James G. Needham. The Jacques Cattell Press, Lancaster, Pa., 1941, i–xi, 1–269. $3.00—A goodhumored, informative, and well written book on the philosophy of human biology.

EDITORIAL NOTES AND NEWS

Editorial Comments

THE editors acknowledge with gratitude the contributions that have been made to this issue of COPEIA. The beautiful colored plates accompanying Dr. Twitty's article on Californian *Triturus* were the gift of STANFORD UNIVERSITY, their cost defrayed in part by a grant from the ROCKEFELLER FOUNDATION. The collotype plates in the same article were provided by the gift fund which was made available to the Society this year through the generosity of an anonymous donor. Additional assistance was received from DR. L. M. KLAUBER and from the MICHIGAN INSTITUTE FOR FISHERIES RESEARCH.

The detailed accounts of the annual meetings of the SOCIETY in New York and of the Western Division at Salt Lake City will appear in a subsequent issue.

Raymond L. Ditmars

IT is a difficult task to prepare a proper record of the passing of a respected colleague. A formal obituary is bound to be unsatisfactory because unnecessary. An appreciation is almost certain to be inadequate, for a man's work can only be properly evaluated with time. In this note I attempt only to acknowledge the debt which science owes to DR. DITMARS.

We herpetologists have known our associate professionally as Curator of Reptiles in the New York Zoological Gardens, a position he held for forty years, and as a popular writer and lecturer on herpetology. These facts and other details of his career mean little, however, unless we understand the objectives of his work.

Unfortunately, zoologists, with some other scientists, too generally disparage attempts to popularize the results of their studies and fail to distinguish between popular writings meant only to entertain and sell and those prepared to stimulate real interests in youthful minds. Science progresses by the production of new investigations as well as by the efforts of trained specialists, and natural histories and manuals have probably been more effective in creating zoologists than all the technical papers which have been written.

The reptiles are a difficult group, the study of which has been made more arduous by an accumulation of superstition and old wives' tales which continue to persist despite their evident absurdity. By presenting the facts about these animals in a careful, unsentimental, but entertaining way, Dr. Ditmars has aroused an intelligent interest in them which will certainly result in an increased number of students of ecology, distribution, and relationships in these sadly neglected vertebrates. Great as will be this contribution to the advancement of knowledge, we are justified in hoping that the example of our colleague will inspire others to take up the difficult task of kindling minds with a desire to know as much as possible of the world of which they are a part.—ALEXANDER G. RUTHVEN, *University of Michigan.*

News Notes

DR. GEORGE S. MYERS, of Stanford University, left in June for South America for a year's study and travel in Brazil, under a grant from the State Department in Washington. He will make his headquarters in the Museu Nacional in Rio de Janeiro, where he will give a series of lectures on Brazilian fishes and fisheries resources, and take charge of the advanced training and research of a selected group of Brazilian ichthyological students. Exploratory collecting trips to various parts of the interior will also be undertaken, the collections to be divided between the Museu Nacional and the Natural History Museum of Stanford University.

PROFESSOR ALBERT EIDE PARR, formerly Director of the Peabody Museum and Director of Marine Research of Yale University, has been made Director of the American Museum of Natural History, succeeding DR. ROY CHAPMAN ANDREWS, who resigned recently.

DR. WILLIAM GOSLINE, formerly of the United States Fish and Wildlife Service, is now with the American Field Service Ambulance Unit in Syria.

DR. L. M. KLAUBER has been appointed lecturer in Natural History at Stanford University.

W. L. SCOFIELD, of the California Division of Fish and Game, has been appointed to the position of Supervisor of Marine Fisheries Statistics. DR. FRANCES N. CLARK will assume the position of Supervisor of the California State Fisheries Laboratory.

DR. JAMES OLIVER has been appointed to the assistant curatorship of the Division of Herpetology of the American Museum.

MR. ARTHUR GREENHALL has been appointed Director of the Portland Zoo, Oregon.

EARL S. HERALD, JACK C. MARR and STANLEY G. JEWETT, JR., former ichthyological and fishery students at Stanford University, are now with the United States Public Health Service doing survey work about army camps.

DR. HOWARD K. GLOYD, Director of the Chicago Academy of Sciences, received the honorary degree of D.Sc. from Ottawa University, his Alma Mater, on the occasion of the 77th Commencement on June 1.

Requests

MAJOR CHAPMAN GRANT, 535 Quince St., San Diego, California, writes that he would like to add to his collection of books and separates on Antillean herpetology, and wishes to hear from members possessing such items for sale or trade.

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